



## ACKNOWLEDGMENTS

The author is indebted to Leslie H. Parmele, agricultural engineer, Northeast Watershed Research Center, Agricultural Research Service, U.S. Department of Agriculture, for his contribution to this paper. This manuscript was prepared in cooperation with the Agricultural Experiment Station of The Pennsylvania State University, University Park, Pa.

Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned.

## CONTENTS

	Page
Introduction . . . . .	1
Digital-recording gages . . . . .	2
Digital punch paper tape . . . . .	3
Gage location identification . . . . .	4
Paper tape data collection . . . . .	5
Paper tape data preparation . . . . .	7
Paper-tape-to-magnetic-tape translation . . . . .	9
Translation procedure errors . . . . .	11
Computer input data . . . . .	12
Card layouts . . . . .	12
Header card . . . . .	12
Page heading cards . . . . .	12
Snow date card . . . . .	13
Control card . . . . .	13
Label card . . . . .	15
Translator error card . . . . .	17
Loss data cards . . . . .	17
Order of input . . . . .	18
Computer source program . . . . .	19
Translator malfunctions and their computer corrections . . . . .	19
Computer output data . . . . .	20
Conclusion . . . . .	25
Appendix I. Gage malfunction error codes . . . . .	26
Appendix II. Computer source program . . . . .	31

# A SYSTEM FOR COLLECTION, PREPARATION, TRANSLATION, AND COMPUTER REDUCTION OF DIGITAL HYDROLOGIC DATA

by Jan C. Carr<sup>1</sup>

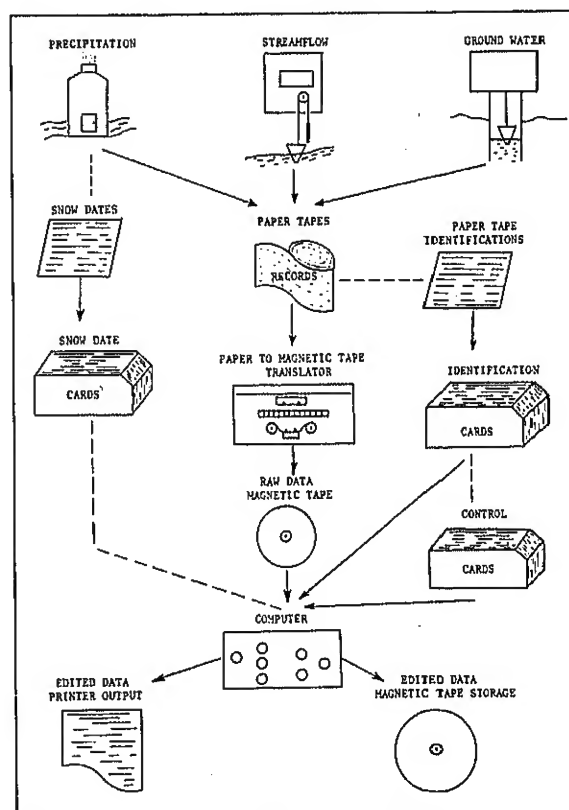
## INTRODUCTION

A system for collection, preparation, translation, and computer reduction of digital hydrologic data has been developed at the Northeast Watershed Research Center, University Park, Pa. This system represents a significant improvement over the tedious handwork of visually recording data from a pen trace chart.

The use of digital-recording hydrologic gages presents several problems in the development of a data-processing system. (1) Visual inspection of recorded data to detect instrument abnormalities and correction or identification of such malfunction errors is practically impossible. Thus, operators rely on the computer for detection of these errors more so than on analog chart data. (2) The amount of recorded data produced is large, because the readout device operates continuously; however, this volume of records is easily handled by high-speed computers. (3) One advantage of this recorder is minimum human-contributed errors. This is due to not having to transfer and correct data from charts to computer input form manually.

Corrections may be made upon digital data records manually, but these are normally restricted to areas that tapes may have torn or that may have been disfigured by the recorder. In this case, the proper gage reading must still be recognizable. (4) The ability of this recorder to run continuously and unattended for long periods of time is a great advantage, because fewer site visits are necessary, and less time is needed to identify, process, and store the records.

The following sections describe this data-collecting and processing system for digital hydrologic data. Field data collected from the Mahantango Research Watershed located near Klingerstown, Pa., was used to illustrate the operation of the system. A flow diagram of the system is shown in figure 1.



<sup>1</sup>Hydrologic technician, Northeast Watershed Research Center, Northeastern Region, Agricultural Research Service, U.S. Department of Agriculture, University Park, Pa.

Figure 1.—A flow diagram of the digital hydrologic data-handling system.

## DIGITAL-RECORDING GAGES

The type of digital recorders used on the Mahantango Watershed network are the Fischer and Porter precipitation gage (fig. 2), water level gage (fig. 3), and tide gage (fig. 4).<sup>2</sup>

The precipitation gage mechanically converts the depth of accumulated precipitation onto a binary-coded, punched paper tape at selected time intervals. This gage has a standard 8-inch orifice, collector capacity of 20.0 inches, and recording accuracy to the nearest 0.1 inch. A rain trace sensor is incorporated within the gage collector to provide a more accurate record of the beginning and ending of precipitation events. This sensor operates normally during summer months. Timing for the collection of precipitation is done by a 5-minute, solid-state electronic timer driven by a d.c. power supply. The 5-minute-interval punch-out provides 105,000 readings per gage during a 1-year period. Of these readings, approximately 500 will suffice to describe precipitation events that occurred during the year.

The water level gage incorporates a float, counter-balance pulley mechanism to transfer streamflow depths onto punched paper tape. This gage operates on

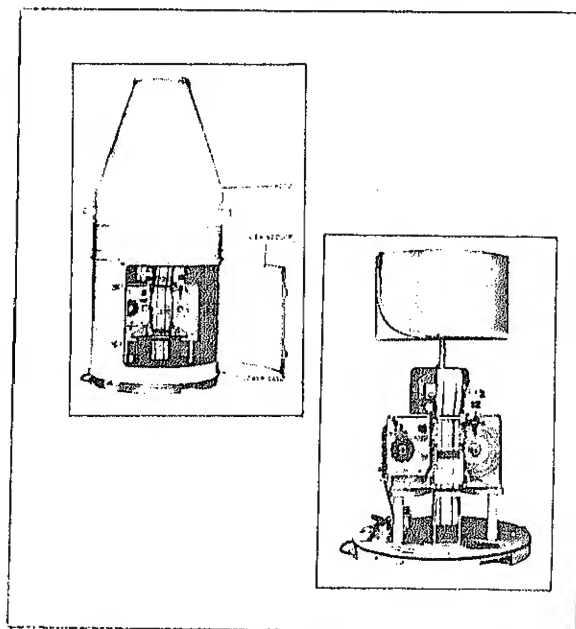


Figure 2.—A digital-recording precipitation gage.

<sup>2</sup>Fischer and Porter Company. Precipitation gage-recorder, Instr. Bul. 35-1558-1, punched-tape level recorder, Instr. Bul. 35-1541-4, Rev. 3, tide gage, Instr. Bul. 35-1550, Rev. 1, 1970.

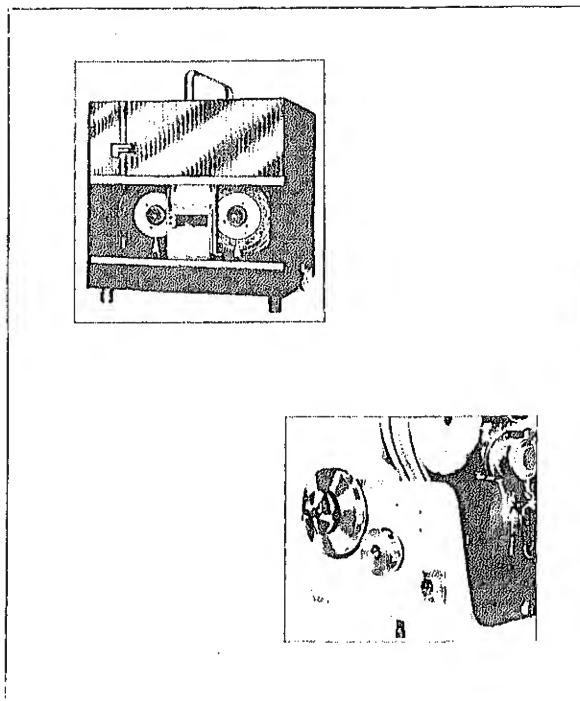


Figure 3.—A digital-recording water level gage (streamflow).

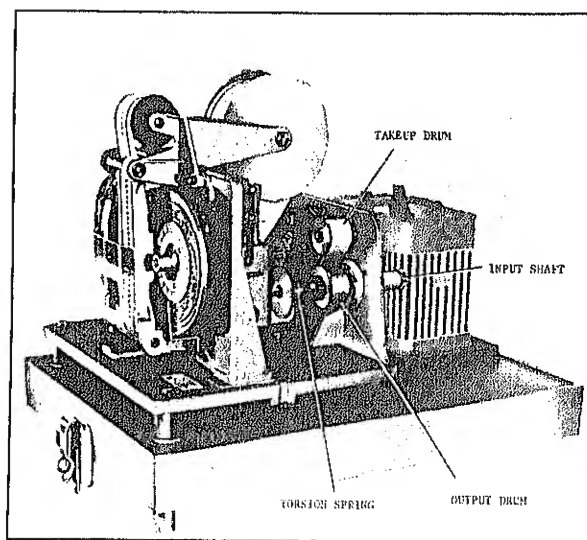


Figure 4.—A digital-recording tide gage (ground water levels).

a 5-minute-interval punchout is the precipitation gage. Approximately 10,000 of the 105,000 readings are needed to depict the fluctuations of stream depths during the year.

The tide gage for recording ground water well levels differs from the water level gage. The gage uses a counterbalance spring in place of a counterweight to facilitate measuring water levels in a well pipe, where sufficient room is not available for a counterweight. Both the tide gage and the water level gage record

continuous water levels to the nearest 0.01 foot up to 50.00 and 99.99 feet, respectively. The tide gage operates on a 30-minute-time-interval punchout, with each of the 17,520 readings per year used to describe continuous well levels during the year.

Each gage's punchout mechanism may be operated manually by means of a switch. This manual operation provides a test on punchout alignment and gage time versus clock time synchronization.

## DIGITAL PUNCH PAPER TAPE

The punch paper tapes shown (fig. 5) have a width of 2 1/8 inches, and a length that varies with available time scales. One day's record with a 5-minute time scale requires 28 5/8 inches of tape length, while a 30-minute time scale requires 4 7/8 inches.

The paper tape is divided along its length into crosswise lines which represent the clock time at which punchout occurs (see fig. 5). A 5-minute tape is identified at 10-minute-increments in the center of the tape. Hour lines are marked by heavier lines and are identified in the military time scale. Each day on the tape is consecutively stamped with red numerals. These provide a count of the total tape days elapsed from beginning to end of a record period.

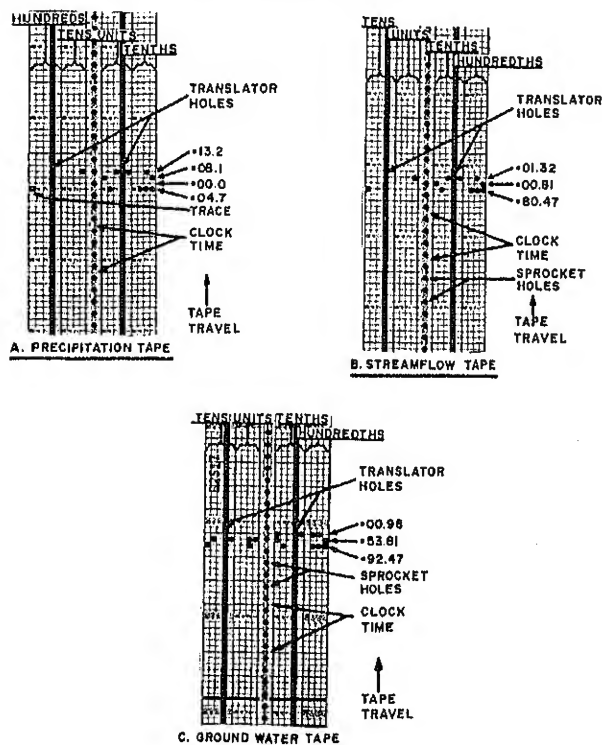


Figure 5.—Digital punch paper tape usage.

The tape is divided into 16 channels, two wide black lines, an area along the tape center that contains the time interval markings, and large sprocket drive holes that are used by the recorder to feed paper tape. The 16 channels are subdivided into four groups of four channels each. In the individual groups, channels are binary coded "1-2-4-8."

Any number can be represented by the appropriate selection of these codes. Those codes not selected are zero. For example, using the tape for precipitation (fig. 5A), a summation of the farthest right-hand group of punched holes establishes the tenths digit. The next group, moving from right to left, gives the units digit, and the third group provides the tens digit. Since the recording accuracy of this gage is to the nearest tenth of an inch, and since capacity is 20 inches, these three groups provide a three-digit precipitation readout, leaving the hundreds digit, or the fourth and final group, unused. Normally, during the summer months when the rain-trace sensor is operative, a trace of rain is noted by a trace punchout in the binary 8 channel of the fourth group.

The punched paper tape (fig. 5B) used in stream-flow recording is identical to the tape in figure 5A, except that the four groups provide a different numerical representation. The first group represents the hundredths digit; the second group, the tenths digit; the third group, the units digit; and the fourth group, the tens digit of a four-digit number. The ground water level punch paper tape (fig. 5C) differs from the streamflow tape (fig. 5B) only in its time scale. The two wide black lines shown on each tape are channels for the placement of translator alignment holes, which are automatically punched in the tape during each 5- or 30-minute-punchout to provide proper tape alignment during the paper-tape-to-magnetic-tape translation.

## GAGE LOCATION IDENTIFICATION

A one-half-square-mile grid system was developed for the Mahantango Watershed to identify each gage by a numerical location code (fig. 6). The north to south grid lines represent parallel longitude, while the east to west lines represent parallel latitude. Grid squares were lettered alphabetically A through U from north to south, and numbered 1 to 65 from east to west, respectively. Further subdivision of individual grids can be provided to give more accurate gage locations.

A prefix was used in conjunction with the gage location to indicate the type of instrument as follows:

- R - An individual rain gage location.
- M - Meteorological sites (rain gage, evaporation, wind, humidity, and temperature station).
- G - Open-channel stream-gaging station.
- W - Weir-control stream-gaging station.
- A - Aquifer (ground water well station).

Example: RG32 is a rain gage recorder station. R designates rain gage, and G32 is the grid square location code of the gage on Line G and Column 32.

A watershed identification number, developed by the Agricultural Research Service, was used to designate the State and watershed location within the State. The State location number assigned to the Mahantango Watershed, Pa., is 16. Each of the six subwatersheds within Mahantango Watershed were numbered 0.01 through 0.06, and the watershed identification numbers, referred to as IWID, are as follows:

Subwatershed	Stream Gage	IWID
Mahantango Creek	GRO4	16.01
Deep Creek	WO16	16.02
Little Mahantango Creek	GK27	16.03
Pine Creek	GM27	16.04
Run Stella Run	WJ30	16.05
Three-Square Mile	WE38	16.06

The combination of watershed identification and gage location numbers provides sufficient numerical representations of a particular gage within a certain watershed.

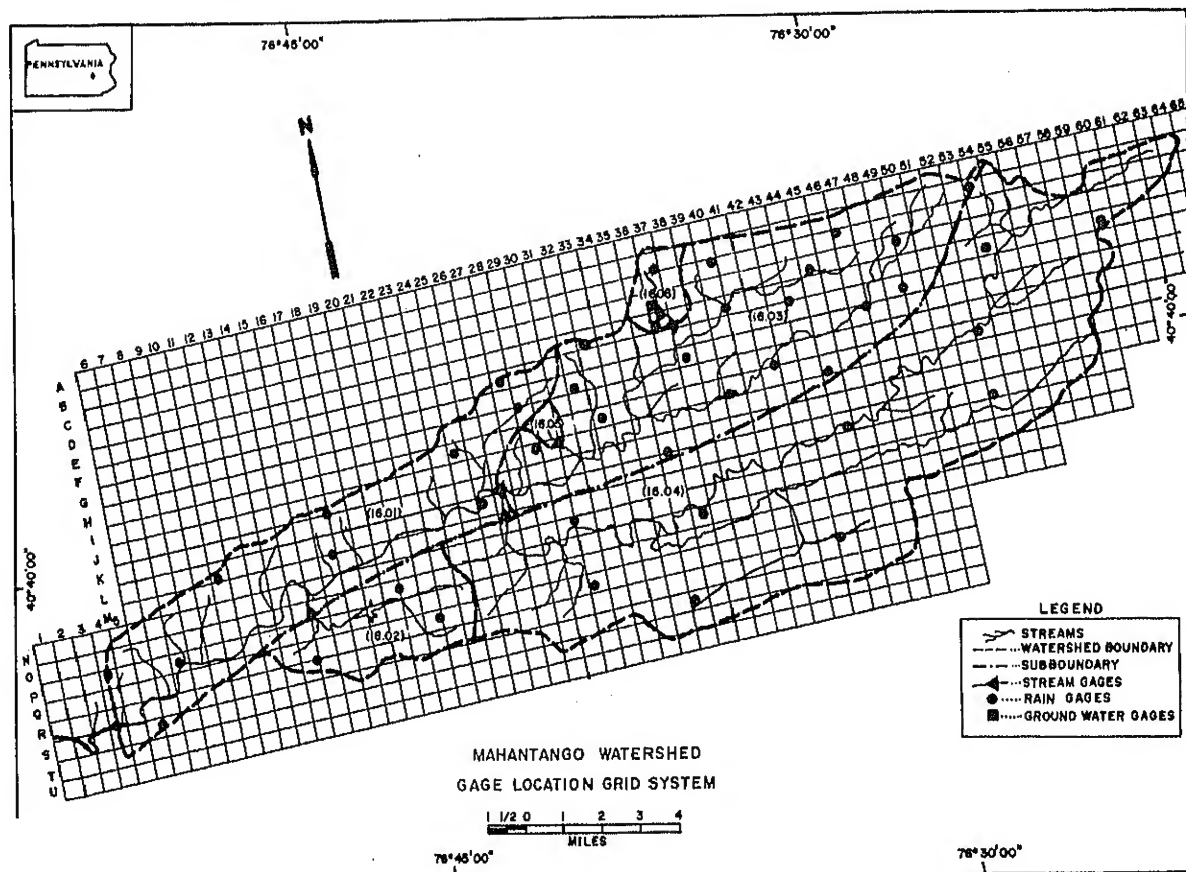


Figure 6.—The gage location grid system.

## PAPER TAPE DATA COLLECTION

The maximum paper tape collection period varies, depending upon the punchout timing cycle. Experience with the Mahantango network has indicated that a monthly collection period is most efficient when those gages are operated on a 5-minute time cycle, and twice a year for those gages on 30-minute cycles. The punched records are stored by the gage on a takeup spool, with the beginning of the collection period located on the inside of the rolled tape.

A 10- to 12-inch length of unpunched tape precedes the punched record. The unpunched area is used to record notes such as gage number, beginning date, time, and punched value. Prior to the start of recording, a series of six or more manually initiated punchouts are placed in the tape in the area beyond the notes. These punchouts supply the feed alignment holes required during the translation procedure. A red felt-tip marker line is drawn across the beginning punchout of the collection period. This line separates the first gage punchout time interval from the preceding manual punchouts and provides a visual notation of the actual beginning of record.

The current paper tape record begins with the time that the previous tape ended, resulting in duplicate punchouts between each collection period. The purpose for following this procedure is to establish a standard method for removal and installation of the paper tape records. The computer reduction step is

designed to take into account that duplicate punchout times exist between each tape record.

Two exceptions to this standard method may occur. A complete loss of data, due to gage failure, would require the following tape to begin with the present watch time, and a special notation of the data loss would be made (see Loss Data Cards, "Computer Input Section"). A time loss or gain, either of which can occur with the digital gage, will also require a special notation. In this case, the beginning punchout of the following paper tape will not be identical with the ending punchout of the previous tape, but the new record would begin with the same watch time as the ending watch time of the preceding period. The special notation in the form of a numerical error code, described under the "Paper Tape Data Preparation" Section, would be noted on the tape record which had the punchout time loss or gain.

With the established method of tape removal and installation, the manual punching mechanism is used to synchronize each paper tape collection period to standard watch time. A minimum of 6 inches of unpunched tape must follow each collection period. This length is needed during the translation procedure. A field check list (table 1) is kept of the paper tape records for each gage. The field notes supply a complete gage history.



TABLE 1.-A field check list depicting information from a precipitation gage recorder

FIELD CHECK LIST FOR F&P RECORDERS		NEWRC-1 (8/67)
INSTRUMENT NO: <u>M 78</u>		
TIMER NO: <u>11-69-2</u>	WATERSHED: <u>Mahantango 1606</u>	
LOCATION NO: <u>M-E 37</u>	LOCATION: <u>Earl Brown</u>	
DATE TO BE SERVICED		
DATE ACTUALLY SERVICED	<u>02-08-72</u>	<u>03-10-72</u>
<b>SYNCHRONIZATION</b>		
Correct E.S.T.	<u>1420</u>	<u>1345</u>
Tape Time	<u>1420</u>	<u>1345</u>
Time Correction	<u>0</u>	<u>None</u>
Tape Day No.	<u>216 72</u>	<u>21704</u>
<b>TAPE SUPPLY</b>		
Supply Tape Replaced	<u>11-02-71</u>	
Tape No.	<u>40+</u>	<u>40+</u>
Days Remaining on Tape	<u>02-08-72</u>	<u>03-10-72</u> ②
Record Removed	<u>Yes</u>	<u>Yes</u>
Notation on Tape		
<b>INSTRUMENT READING</b>		
Dial Reading	<u>3.7</u>	<u>9.7</u>
Tape Reading	<u>3.7</u>	<u>9.7</u>
Punchout in Line	<u>Yes</u>	<u>Yes</u>
Punchout Clean	<u>Yes</u>	<u>Yes</u>
Sensitivity Checked	<u>Yes</u>	<u>Yes</u>
Range Adjusted	<u>02-16-70</u>	<u>NO</u>
Zero Adjusted	<u>01-11-72</u>	<u>03-10-72</u>
Collector Emptied	<u>01-11-72</u>	<u>03-10-72</u>
Calibration Made	<u>10-12-71</u>	<u>03-10-72</u>
<b>BATTERY SUPPLY</b>		
Battery Replaced	<u>10-12-71</u>	<u>03-10-72</u>
Voltage Across Battery	<u>7.2</u>	<u>7.8</u>
Voltage Across Motor	<u>7.1</u>	<u>7.7</u>
ma Drain of Timer	<u>6</u>	<u>4</u>
ma Drain at Punchout	<u>145</u>	<u>135</u>
<b>OPERATION</b>		
Evap. Suppression Oil	<u>01-11-72</u>	<u>03-10-72</u>
Dashpot Fluid Added	<u>NO</u>	<u>NO</u>
Contacts Cleaned	<u>02-08-72</u>	<u>03-10-72</u>
Material in Collector	<u>NO</u>	<u>NO</u>
Mechanical Malfunction	<u>NO</u>	<u>NO</u>
<b>SEASONAL OPERATION</b>		
Trace (In or Out)	<u>OUT</u>	<u>IN</u> ③
Trace Battery Voltage	<u>6.8</u>	
Funnel (In or Out)	<u>OUT</u>	<u>IN</u>
Antifreeze Installed	<u>01-11-72 250</u>	<u>NO</u>
GAGE SERVICED BY	<u>M.P.</u>	<u>M.P.</u>

①② (Make Additional Comments on Back)

## PAPER TAPE DATA PREPARATION

A hand-operated roller is used to rewind the paper tape record to place the beginning of the record period on the outside of the roll. The hollow core of the rewound tape must be at least three-fourths of an inch in diameter to meet the requirements of the translator supply spool. During the rewinding of the tape, a visual

scan is made for detectable errors. A four-digit, error-coding system was developed for use in identifying any gage malfunctions, such as time loss or gain. Each paper tape record is coded by one of these error codes (App. 1). The rerolled paper tape records are labeled (fig. 7) as to State watershed number (IWID),

1778 171606 52523 1438 3079 1345 9.7 14.2 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 .08 .04 .02 .01 .08 .04 .02 .01		PRECIPITATION DATA TRACE OUT WATERSHED NO. M1606 M-E37 TIME INT. 5 min. START: DATE 02-08-72 TIME 1420 VALUE 3.7 inches ENDING: DATE 03-10-72 TIME 1345 VALUE 9.7 inches 1000 M. Paul	2 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 .08 .04 .02 .01 .08 .04 .02 .01
--	--	---	--

Figure 7.—A paper tape record identification label.

gage location number, trace operation, punchout time interval, beginning and ending date, time, punched value, and error code.

The information from the tape identification labels is transferred to a "paper tape identification form" (table 2). Each horizontal line represents a record

TABLE 2.—Paper tape identification form (precipitation, streamflow, and ground water)

PAPERTAPE IDENTIFICATION FORM -- PRECIP, RUNOFF, AQUIFER																																								NWRDP - 3						
STATE: PA. IWID: 16.06 WATERSHED: MAHANTANGO CK. YEAR: 1970																																														
ERROR CODE	GAGE NAME									TAPE ON										TAPE OFF										TRANSLATOR CODE																
										P U N C H	T R A C E	O N	D A T E	Y E A R	H R.	M N.	R E A D	H O.	D A T E	Y E A R	H R.	M N.	R E A D	C L I C K	T I M E	E L E V.	R E F.																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42					
1000	WE38	U													052	0101	1970	1250	0023	0204	1970	1700	0019																							
1020	WE38	U													052	0204	1970	1700	0019	0305	1970	0835	0052																							
TIME LOSS NO. APPARENT REASON AT 02-13-1970 1820 GAGE STOP																																														
1000	WE38	U													052	0305	1970	0835	0052	0404	1970	1825	0031																							
1000	WE38	U													052	0404	1970	1825	0031	0508	1970	1810	0021																							
1022	WE38	U													052	0508	1970	1810	0021	0618	1970	1320	0083																							
ONE DAY AND 2 HOUR TIME LOSS LEAF SWITCH BROKE GAGE STOP																																														
1000	WE38	U													052	0618	1970	1320	0083	0717	1970	0800	0061																							
1000	WE38	U													052	0717	1970	0800	0061	0821	1970	0915	0020																							
1000	WE38	U													052	0821	1970	0915	0020	1001	1970	1115	0018																							
1000	WE38	U													052	1001	1970	1115	0018	1110	1970	1200	0081																							
1000	WE38	U													052	1110	1970	1200	0081	1215	1970	1315	0052																							
1000	WE38	U													052	1215	1970	1315	0052	0101	1971	0800	0060																							

Key: Examples  
Error Code: 1000 Good Tape  
Gage Name: WE38D (Col. 5 thru 9)  
Punch: 05 5 minutes

Type: 1 = Precip., 2 = Runoff,  
3 = Aquifer  
Trace: 1 = On, 0 = Off  
Translator Codes:

CHEK: Improper Tape Control  
LIST: 1 = List Data, 0 = No  
ITCH: 1 = Half, 0 = OK  
DATA: 1 = Loss Data, 0 = OK  
ELE REF: Elev. of Aquifer

Card Columns	Identification
1-4	The paper tape error code.
5-16	The gage location number.
17-18	The punchout time interval.
19	The type of data.
20	The trace indicator code.
21-32	Beginning time—month, day, year, hour, and minutes, respectively.
33-36	The first punched-data value.
37-48	Ending time—month, day, year, hour, and minute, respectively.
49-52	The last punched-data value.
53	Translation error codes.
54-56	Computer control codes.
57-62	Mean sea level (ground water recordings only).

precipitation where the key at the bottom of the form explains the proper coding used under the "Type of Precipitation" column.

TABLE 3.—Snow date form table

[illegible]

Type Key: S = Snow  
L = Sleet  
M = Mixed Precipitation (Rain, Snow, Sleet)  
N = Rain and Snow  
H = Hail

Digital paper tape records in the original form cannot be used as direct input to digital computers without special interface equipment. Therefore, the paper tape data must be converted to a suitable media (usually cards or magnetic tape). This Center employs the paper-tape-to-magnetic-tape converting method.

data being translated. The paper tape readings are converted to magnetic tape at a rate of 18 paper tape time intervals per second. The records are automatically blocked every 1,020 digits. An interrecord gap of three-fourths of an inch is written between each block. This blocking, combined with the interrecord gap, meets the requirements of most computer magnetic-tape reading devices.

The 11-digit control is available to enter the label information from the paper tapes being translated. This

9

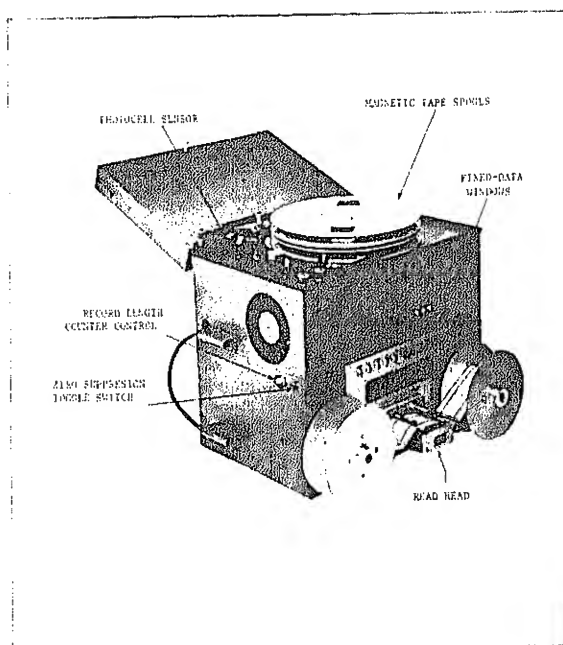


Figure 8.—A paper-tape-to-magnetic-tape translator.

method of entering the label information onto the magnetic tape is slow and provides opportunity for human error. Thus, the 11-digit control is not used with this translation procedure, since the label information will be fed into the computer through cards keypunched from the "Paper Tape Identification Form" (table 2).

The four-digit control has a twofold purpose. It is used to enter data from the paper tape record when misaligned punched readings cause the translator to stop. The value of the punched reading missed may be entered directly on the magnetic tape in the last four windows of the 11 windows. Since each paper tape record represents a different collection period and possibly a new error code, every paper tape record is translated as a separate record. To enable the computer to differentiate between paper tapes, a numerical code of 9999 is written on the magnetic tape through the use of the number 4 digit control. The "four 9's" code signals the end of a paper tape record and is applied after each paper tape's translation.

The original design of the model 1730 translator was such that zero gage readings, nonpunched values, could not be read. This feature allowed the translator to stop translation of a paper tape when the 6-inch blank span at the end of the paper tape was encountered. The ability to translate zero readings is necessary when precipitation data are being converted.

The construction of the precipitation gage is such that after a collection of 15.0 to 19.9 inches of precipitation, the collector part must be emptied and the following recording period begun with zero gage readings. These zero readings will be present on the paper tape until the first precipitation event. To provide for precipitation data translation, the model 1730 was modified by installation of a "zero suppression" toggle switch. This switch resides in one of two positions, normal or nonnormal. The normal position does not allow the translator to read zero values, thus stopping translation on encounter with unpunched tape, and the nonnormal position allows translation of zero gage values.

The procedure for paper-tape-to-magnetic-tape translation can vary with the model 1730, but with ease of operation and speed as a criteria, the following step-by-step procedure is recommended:

1. Load the magnetic tape on a supply spool that is located on top of the translator and hand threaded through the proper path to a takeup spool. A tape-loading diagram is supplied by the manufacturer. The tape spools handle varied sizes of computer magnetic tape up to 10 1/2-inch reels.
2. Set *Recorder Mode Switch* to the *record* position and turn power on. The function of the *Recorder Mode Switch* is to specify one of the following three options: *record*, *rewind*, and *fast forward wind*.
3. Press the *Record Length Counter* (RLC) control. This control energizes the magnetic tape blocking counter. Every 1,020 digits are blocked, plus an interrecord gap on the magnetic tape, by the automatic blocking feature.
4. Press *Begin of Magnetic Tape* (BOT) control. The magnetic tape advances until a photocell sensing light encounters an aluminum foil reflective mark attached to the tape some 10 feet into the supply spool. The mark provides an exact starting point for recording, which enables a computer-tape-read device to index at the proper beginning of the magnetic tape data.
5. Set *Zero Suppression Switch* to the normal position if reading nonzero paper tape data. Set to the nonnormal position to read data with beginning zero values.
6. Load first paper tape record onto the translator-read head. The beginning of record on the paper tape, as identified by the red marker line, is aligned so as to be the first punched value

read and converted. Proper indexing of this line assures the appropriate beginning clock and paper tape time synchronization.

7. Press *Start Control Button*. The paper-tape-to-magnetic-tape conversion continues until the end of the paper tape is encountered. The position of the *Zero Suppression Switch* is important during the translation. If the switch position was nonnormal at the start of translation, it must be placed at the normal position as soon as the first nonzero punched values appear in the paper tape. If the translation stops because of misaligned paper tape punches, the value of the reading prior to the stop point is dialed into the last (most right hand) four fixed-data windows, and the number 4 control is pressed. This reading is converted to the magnetic tape. Repress the *Start Control*. Translation will continue until the blank span

at end of paper tape automatically stops translator.

8. Remove the paper tape from the translator-read head. Dial 9999 code into the last four fixed-data windows and press 4 control. This code is applied after the translation of each paper tape. A paper tape requires from 4 to 6 minutes for loading, translation, and removal.
9. Place two end-of-file marks, by means of an *EOF Control*, when the last paper tape record for the run has been translated, and the four 9's code has been applied. The end-of-file marks are recognized by the computer as the end of all data on the magnetic tape. The feature is used only as an end of all data.
10. Place the *Record Mode Switch* in the *Rewind position* after completion of the translation. The magnetic tape rewinds onto the supply spool and is removed, identified, and stored prior to computer reduction.

## TRANSLATION PROCEDURE ERRORS

The translation procedure can provide some opportunities for human error. A translator operator may mistakenly write on the magnetic tape an incorrect control code at the end of a paper tape. The operator, realizing that the error may have occurred, can take appropriate steps to have the computer correct the error by use of the proper numerical code from table 4.

TABLE 4.—Translator operator errors

(Coded in Column 53, Paper Tape Identification Form)

Code	Type of Translator Operator Error
0 or Blank	No errors during paper tape translation.
1	The four 9's, or EOF end-of-paper-tape control, left off magnetic tape after the paper tape translation.
2	Two end-of-paper-tape controls of four 9's or EOFs were mistakenly written on magnetic tape.
3	A value other than the four 9's or EOF control was written on magnetic tape.
4	The "Zero Suppression" switch left in the non-normal position. Paper tape continued to run, extra zeros on magnetic tape. The four 9's or EOF control was placed at end of the zeros.
5	The same problem as Code 4, except failed to write the four 9's control on magnetic tape at end of zeros.

The desired code is entered in column 53 of the Paper Tape Identification Form (table 2), opposite the paper tape on which the error occurred. Any code from table 4, other than zero or blank, tells the computer to use a supplied ending date and time to determine the end of a paper tape. If the instrument error code (App. 1) for the paper tape is 1,000, with good data tape with no apparent errors, the supplied ending date and time for the tape would be the same as the ending date and time shown on the tape label.

When the instrument error code specifies a time gain or loss, a manually calculated ending date and time for the paper tape must be determined. This calculation is performed as follows: (a) Count the number of punch-out intervals for the paper tape period, which will give the number of 5- or 30-minute intervals for the tape period. (b) Divide the count into days, hours, and minutes, and add to the paper tape's beginning punchout date and time, which establishes the actual tape punchout ending date and time. (c) Keypunch this time on a data card. The description of this extra card (Translator Error Card) is given in the next section.

## COMPUTER INPUT DATA

The computer input consists of both keypunch cards and the translator-produced magnetic tape. The cards are standard 80-column punchcards. The input card variables, proper coding of these variables, and the type of format are described under each card layout. The following format code is adhered to:

- I = Integer number, right justified in card field.
- F = Real number, contains a decimal point location. Decimal point not punched on the card.
- A = Alphanumeric, number or letter, left justified in the card field.
- X = Blank card field, not used.

## CARD LAYOUTS

### Header Card (One Card—Required)

Variable	NHEAD	NSC
Format Code	I1	I3
Card		
Columns	1	2-4

### Page Heading Cards

(A maximum of three cards, the number of cards must equal to NHEAD on the "Header Card"). (If NHEAD equals zero, this card layout is not needed).

Variable	HCARD(x) <sup>1</sup>
Format Code	54A1
Card	
Columns	1-54

<sup>1</sup>The "x" notates an integer from 1 through 3.

Variable	Description
NHEAD	The number of "page heading cards" to be read and written as headings on each computer output page. A maximum of three "page heading cards" may be read and written. This code is zero if no page headings are to be written on the printer.
NSC	The number of "snow date cards" to be read into storage. A zero coding indicates no "snow date cards" to be read. A maximum of 999 cards may be read. (See snow date card layout below).

Variable	Description
HCARD	Output Identification (See example below). Example: "Basic Precipitation Data (Break Point)" for HCARD (1). "NEWRC, University Park, Pa.", for HCARD (2). "_____", for HCARD (3). Note: The State, watershed, and gage names are automatically written following the page headings. These variables receive values from the following control and label card layouts.

### Snow Date Card

(Optional cards, use by precipitation data only, one card for each day of precipitation other than snow).

Note: If NSC on header card is zero, this card layout is not needed.

Variable	NSDTE(x,1) <sup>2</sup>	NSDTE(x,2) <sup>2</sup>	NSDTE(x,3) <sup>2</sup>	STYPE(x) <sup>2</sup>
Format Code	I2	I2	I2	A1
Card				
Columns	1-2	3-4	5-6	7

<sup>2</sup>Numbers in parentheses represents indexes of computer storage tables. The "x" denotes a number beginning with 1 and ascending to 999. This provides storage for a possible 999 days of snowfall or similar precipitation.

Variable	Description	The snow date cards are punched directly from the "snow date record form" on table 3.
NSDTE (x,1)	The month.	
NSDTE (x,2)	The day.	
NSDTE (x,3)	The last two digits of the year.	
STYPE (x)	The type of precipitation, see "snow date" form (table 1) for proper coding.	The following card layouts serve as program control and paper tape records information. The main portion of the card variables described obtain values from the "paper tape identification form" (table 2). Cards may be keypunched directly from this form.

### Control Card

(One card for each different gage's paper tape records contained on the translator magnetic tape)  
(Required).

Variable	STATE	IWID	WSH	GAGE	NPFG	NTPT	IEOF
Format Code	A3	I4	16A1	3A4	I2	I2	I1
Card							
Columns	1-3	4-7	8-23	24-35	36-37	38-39	40
	IT	KT	OUT2	NSKIP	NOEOF	KT1	KT2
	I2	I2	A6	I1	I2	I2	I2
	41-42	43-44	45-50	51	52-53	54-55	56-57
	KT3	KT4	NDST	NEWDAT	IGREF		
	I2	I2	I1	I1	I4		
	58-59	60-61	62	63	64-67		

Variable	Description	GAGE	The gage location identification (example: Gage = RE38) (Maximum of 12 characters).
STATE	The abbreviated State name, (example: Pennsylvania = Pa.).		
IWID	The State watershed location number (example: Mahantango Ck., Pa. = 1601).	NPFG	The number of paper tape records for the gage (example: NPFG = 12, paper tape records for the period are 12).
WSH	The watershed name (example: Mahantango Ck.).		



Variable	Description	Variable	Description
NTPT	The total number of paper tape records on the translator magnetic tape. This variable will be coded the same on each control card for the process.		of four output storage tapes may be used during one processing. Each would be end-of-filed at end of process.
IEOF	If 9999 (four 9's) is written on translator tape after each paper tape, IEOF = 0. If end-of-file marks (EOF) are written after each paper tape, IEOF = 1.	NDST	This code is used in special cases where a dual-control, stream gaging station exists, one control for measuring low flows and another for measuring high flows. In this special case, NDST would be coded as zero for the high-flow control and as 1 for the low-flow control. When runoff data is from a single control station, NDST would be coded as zero. The NDST code is used in later processing to identify the proper rating table or curve to be used in computing discharge.
IT	The computer-read unit number on which the translator tape will be mounted during processing (Example: IT = 01).		
KT	The computer-write unit number on which the output storage magnetic tape will be mounted. (Example: KT = 03).		
OUT2	The magnetic tape volume name on which the output storage data will be written (Example: OUT2 = MAH333).	NEWDAT	This variable, when coded 1, specifies that a different type of hydrologic data will follow the present data. A new header card must be read following the last paper tape record of this control card. NEWDAT will be coded zero if same type of data is to follow.
NSKIP	When coded as 1, this variable will initiate a readout of a specified number of paper tape records from the translator tape. The paper tapes read will be ignored, and processing will commence on the paper tape immediately following the last paper readout. The number of paper tapes to be read out will be coded under the following NOEOF variable. If no paper tape records are to be skipped, NSKIP will be coded as zero, and processing will begin on the first paper tape.		
NOEOF	The number of paper tape records to be skipped on readout if NSKIP equals 1. NOEOF equals zero if NSKIP equals zero.	IGREF	The maximum change in gage-recorded amount that may occur in a given time interval, or maximum gage height allowed. This variable is necessary because of the possibility of erroneous punchouts on the paper tape by the digital-recording gage. If any gage-punched reading for a given time interval exceeds the value of this variable, the data is considered invalid and is ignored by the computer. Default values for the three types of hydrologic data will be used when IGREF equals zero. These defaults are as follows: (a) a maximum of 1-inch change in precipitation amount in a 5-minute interval, (b) a maximum of 30.00-foot gage depth for any runoff amount, (c) a maximum of 60.00-foot gage depth for any ground water level.
KT1, KT2, KT3, and KT4	These variables are control codes used by the computer in writing an end-of-file on the output storage magnetic tape or tapes at completion of processing. The proper coding for these variables would be the same as the "KT" variables used on any or all control cards. (Example: KT1 = 03, because one magnetic storage tape is used and the tape to be end-filed is KT = 03). A maximum		

### Label Card

(One card for each paper tape record contained on the translator tape) (Required).

Note: The card columns of this card are identical to the columns of the "paper tape identification form."

Variable	NCOD	GAG	NPIL	NTYPE	NTRACE
Format	I4	3A4	I2	I1	I2
Card					
Columns	1-4	5-16	17-18	19	20
	MT1	ND1	NY11	NY1	NH1
	I2	I2	I2	I2	I2
	21-22	23-24	25-26	27-28	29-30
	NM1	ARD1	MT2	ND2	NY22
	I2	FH.2	I2	I2	I2
	31-32	33-36	37-38	39-40	41-42
	NY2	NH2	NM2	ARD2	ICHECK
	I2	I2	I2	F4.2	I1
	43-44	45-46	47-48	49-52	53
	NLIST	ITCHG	LDATA	ELEREF	
	I1	I1	I1	F6.2	
	54	55	56	57-62	

Variable	Description	Variable	Description
NCOD	The gage malfunction error code for the paper tape record. (Example: NCOD 1,000 is good data) (See Error Codes, App. 1).	NTRACE	If the rain-trace sensor on a rain gage is in operation for the paper tape, NTRACE = 1, if sensor out of operation, NTRACE = 0. If processing runoff or ground water data, NTRACE = 0.
GAG	The gage location identification, this variable is coded the same as "GAGE" on the control card for this gage (Example: RE38 _____).	MT1	The paper tape beginning month.
NPIL	The paper tape punchout time interval (Example: 05 for a 5-minute punch interval).	ND1	The paper tape beginning day.
NTYPE	The type of data being processed, NTYPE will equal 1 for precipitation, 2 for streamflow, and 3 for ground water data.	NY11	The first two digits of the beginning year (Example: 1970, NY11 = 19).
		NY1	The last two digits of the beginning year (Example: 1970, NY1 = 70).
		NH1	The beginning hour (military watch time, 24 for midnight).

Variable	Description	Variable	Description
NM1	The beginning minutes. (This variable should be a multiple of 5 or 30). (Example: If NM1 = 15 for 15 minutes after the hour, the paper tape time cycle is every 5 minutes).	ITCHG	If a precipitation trace sensor malfunction under "NCOD" above occurred during the record period, and if the trace sensor is to be ignored, ITCHG would be coded as 1. ITCHG would equal zero in all other cases.
ARD1	The beginning punchout reading (Example: 000.0 = zero precipitation, 01.00 = 1 foot of stream depth, etc.). (Decimal point not punched; therefore, data must be right justified about the decimal point).	LDATA	This variable describes the number of comment cards (loss data cards) that are to be read immediately following this label card or a translator error card, if present (LDATA may have a value of zero through 9). If LDATA is equal to zero, no loss data cards will be read.
MT2	The paper tape ending month.	ELEREF	Used by ground water well data only. This variable is coded with the value of mean sea level elevation when the top of a ground water well is reference to elevation. The output data would be values of elevation in place of gage-reading depths. If the well is not referenced to mean sea level elevation, the variable ELEREF would be coded as zero, and the output would be gage-reading water depths in feet. The maximum elevation of a well at ground level is 9999.99 feet (Decimal point not punched).
ND2	The ending day.		
NY22	The first two digits of the ending year.		
NY2	The last two digits of the ending year.		
NH2	The ending hour (military watch time).		
NM2	The ending minutes (a multiple of 5 or 30).		
ARD2	The ending punchout reading (decimal point not punched).		
ICHECK	The coding of this variable pertains to the end of paper tape control of four 9's. The proper coding is found under the "translator operator errors" in table 4 and Column 53 of the paper tape identification for table 2. (See "Translator Error Card" below).		
NLIST	Used on runoff or ground water data only. If all output records are to be listed on a printer, NLIST will equal 1. If only the page headings, the first and last record for each paper tape period and a summary for each paper tape are to be printed on output, NLIST will equal zero. The precipitation data is automatically listed, and in this case, NLIST would be coded as zero.		

The following cards can be inserted in the input data card deck immediately following the paper tape label card. The first, a "Translator Error Card," will be needed in the event that a translator operator's error occurred at the time of translation, and the gage malfunction error code (NCOD) is for a time gain or loss. The second, "Loss Data Cards," can be used to note a period of data loss between or during paper tape collection periods.

**Translator Error Card**  
(Optional card after a label card)

Note: If "ICHECK," under Label Card above does not equal zero for the paper tape record, this card must be present in the input deck. The format of this card coincides with the format of the "Label Card" above.

Variable	BLANK	IMO	IDA	IY	IYR	IHR	IMN
Format	36X	12	12	12	12	12	12
Card							
Columns	1-36	37-38	39-40	41-42	43-44	45-46	47-48
	ARED						
	F4.2						
	49-52						

Variable	Description	Variable	Description
BLANK	36 blanks are not used. These blanks orient the card variables to coincide with the "Label Card" format.	IYR	The last two digits of the computed-tape ending year (Example: 1970, IYR = 70).
IMO	The computed-paper-tape-record ending month (See "Translation Procedure Errors" Section).	IHR	The tape ending hour (military time).
IDA	The computed-paper-tape-record ending day.	IMN	The tape ending minutes (IMN must be a multiple of 5 or 30).
IY	The first two digits of the computed-tape ending year (Example: 1970, IY = 19).	ARED	The ending punch-out value (Decimal not punched).

**Loss Data Cards**

(Optional cards after the "Translator Error Card" or "Label Card"). These cards are used to note a loss of data between two paper tapes.

Note: A maximum of nine cards allowable.

Variable	ACARD
Format	80A1
Card	
Columns	1-80

Variable	Description	Variable	Description
ACARD	Comments for output on the data listing. The "LDATA" code under the label card layout must be greater than zero to read "Loss Data Cards." The number of		loss data cards read and printed will equal the LDATA code from the label card of the preceding paper tape.

## ORDER OF INPUT

The Input Data Cards are stacked in the following order:

1. Header Card (one card, required).
2. Page-Heading Cards (maximum of three cards, optional).
3. Snow Date Cards (maximum of 999 cards, optional).
4. Control Card (one card, required).
5. Label Card (one card, required).
6. Translator Error Card (one card, optional).
7. Loss Data Card (maximum of nine cards, optional).
8. Repeat steps 5 through 7 for each paper tape record for a gage.
9. Repeat steps 4 through 8 for each gage's data.
10. Repeat steps 1 through 9 for each type of data on the translator magnetic tape.

(A typical stacking order is illustrated in figure 9.)

The translator magnetic tape contains the basic input data. The physical makeup of this tape is a long, continuous string of digits, each four digits representing a 5- or 30-minute-interval data entry. An imaginary decimal point is located between the third and fourth digits for precipitation data and between the second and third digits for runoff and ground water data. The presence of a number 8 in the first digit of a precipitation reading signals a trace sensor indicator. The occasional appearance of four 9's represents an end of a paper tape record. Following every 1,020

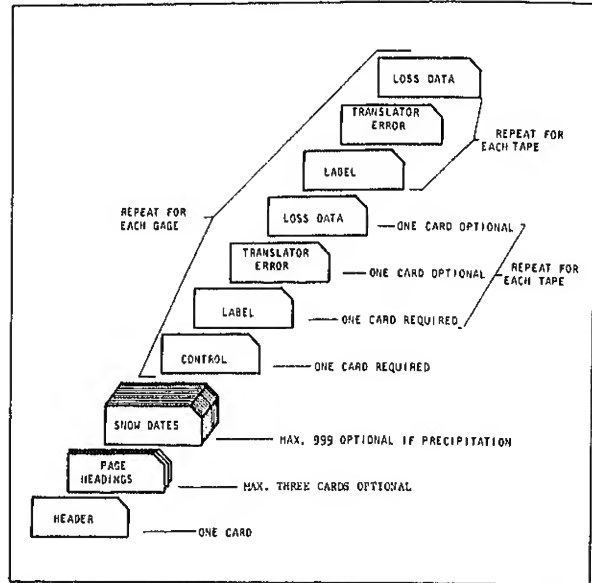


Figure 9.—A typical input-data-cards stacking order.

digits, a blank space and unprinted line indicate an interrecord gap. A pictorial view of a section of data listed from a translator magnetic tape is illustrated in figure 10. A "box" encloses a group of four 9's to aid recognition.

The combination of input cards and translator magnetic tape completes the input data requirement of the processing computer program.

[illegible]

Figure 10.—A pictorial view of a section of data listed from a translator magnetic tape.

## COMPUTER SOURCE PROGRAM

The computer program developed to reduce the digital hydrologic data was written in Fortran IV language for use on an IBM 360/67 computer system.<sup>4</sup> This source program is comprised of a main program and nine subroutine subprograms to aid in program "debugging" and because of their ease in following the program's flow direction.

A major function of the program is to edit the data for extraneous gage readings from the translator magnetic tape and to retain only those gage readings that are needed to reproduce the hydrologic events for a record period. These values with appropriate date and time, gage malfunction error code, and other identifying information are listed on a printer and written on magnetic tape storage as output. A complete errors edit is performed using information from the Translator Operator's Error or Loss Data Cards.

The appropriate action is taken by the program to identify these errors by printed messages on the output media. The program does not attempt corrections of gage malfunction errors. The error codes provide sufficient information for a later step in data correction and analysis. The program was written to enable the reduction of all three types of digital hydrologic data: streamflow, precipitation, and ground water wells.

A normal method would be to reduce each type of data separately, avoiding a mixture of the three types of data on a single magnetic storage tape.<sup>5</sup> One type of data per storage tape provides a less complicated data retrieval at a later date. A source program and input-data loading order is illustrated in figure 11. The // and /\* cards are computer residence cards, which can vary from one computational center to another. A listing of the program is given in Appendix II.

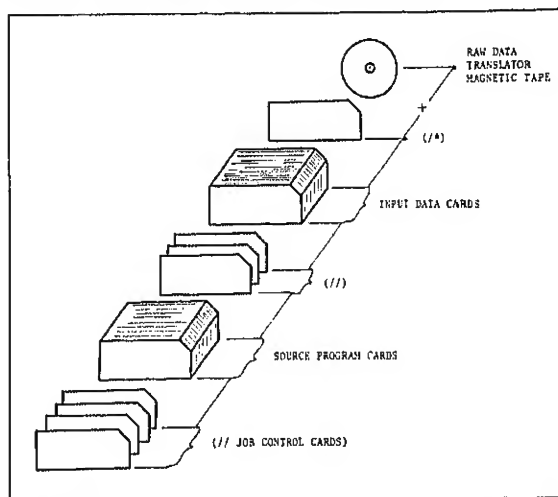


Figure 11.—A diagram of the computer source program and input-data loading order.

## TRANSLATOR MALFUNCTIONS AND THEIR COMPUTER CORRECTIONS

The paper-tape-to-magnetic-tape translator places data on the magnetic tape in a binary-coded decimal form. The signal strength of each digit must lie within the acceptable signal strength range of the computer device used to read the magnetic tape. It has been found with the Model 1730 translator that the signal strength of an individual digit occasionally may fall outside this acceptable range. Consequently, an invalid character is usually substituted for the correct 0-to-9 digit.

This invalid character will cause the program to stop execution, and the data on the magnetic tape beyond this point becomes inaccessible in the current job step. This character results in an error code IHC215I on the IBM 360/67 system. It can be bypassed by the use of

the ERRSET subroutine. An example of the invalid character might be 01'3 instead of 0123. The ERRSET statement simply informs the computer to take the invalid character (') and to convert it to a valid digit (1). This results in a usable four-digit number (0113). The one digit is obtained from the last argument in the CALL ERRSET statement. Likewise, the second argument (256) allows for 256 of the IHC215I errors before program execution is completely terminated. The values of these two arguments is arbitrary within certain limits (See Ref. No. 3).

A second translator malfunction that can occur with the model 1730, although less frequently, is a permanent input error (IBM-IHC218I). This error is also produced from a weak signal on the translator mag-

<sup>4</sup>IBM Corporation. IBM system/360 operating system, Fortran IV (G) Programmer's Guide, File No. S360-25, Form No. C28-6639-1. 1966.

<sup>5</sup>Shanholtz, V. O., and Burford, J. B. Computer systems for reduction and analysis of hydrologic data. U.S. Dept. Agr., Agr. Res. Serv., ARS 41-132. 1967.

netic tape. When the computer attempts to read a record and is unable to recognize the value as valid, the `ERR =` argument of the input data `READ` statement (main program, App. II) instructs the computer to reread the record in error. The record is reread numerous times in an attempt to receive a valid value. If a recognizable value is obtained, the program execution continues. If not, execution fails, and the processing stops.

Following the use of either of these correction routines, the computer reduction program is designed to ignore the corrected record if its value is above or below a set amount when compared with the preceding and following record.

However, the occurrence of these malfunctions is rare. The use of very high-quality magnetic tape in the translation process can help to reduce the possibility of a translator malfunction.

## COMPUTER OUTPUT DATA

The output data from the computer reduction step can be written via a printer and/or placed on permanent magnetic storage tape.

An example of the printer output is given in figure 12 and illustrates one paper tape record period from Rain gage RR-44, Mahantango Creek Watershed. The collection period began 9/9/69 at 1020 with zero rainfall and ended 10/7/69 at 1100 with 2.6 inches of accumulated rainfall. During this period, the rain trace indicator was in operation and is noted on the records with a "T" as trace rainfall. The "type" column is blank, because only rainfall was measured, not snowfall or other similar precipitation.

The blank line spaces across the listing are rainfall event separators. These represent an hour or more between the end of one rain and the beginning of another. The footnotes describe the computer versus the watch-time ending of the paper tape, the number of basic records written on magnetic tape, the number of records read and analyzed, and the type of rain gage malfunction error for the collection period.

The streamflow output listing (fig. 13) depicts a recording period of 6 days from stream gage WE38U. In this example, the "list" option, described as "NLIST" in the "Computer Input Data" section, is in effect. The output is similar to the precipitation listing in Gage No., Date, Time, and Code columns. The "Time Intr" column represents the number of 5-minute intervals during which the stream level remained at the corresponding gage depth under the "Depth (FT)" column. The presence of zero in the "Discharge Table No" column indicates that the data record is from a large control of a "dual-control gaging station." The footnotes follow the same format as that in the precipitation data listing.

The printed output from ground water well data as shown (fig. 14) is generally the same as output from streamflow. This output is also a result of the "List" option effect. The "NREFE" column indicates, by the presence of a blank, that gage depths are actual instrument readings not referenced to M.S.L. elevation. Every 2400-hour reading for the entire record period is listed and written on the magnetic tape for both the ground water and the streamflow data.

When the list option (NLIST) is coded as zero, the printed output for each ground water well or streamflow paper tape will contain only the page and column headings, the first and last record written on magnetic tape storage, and footnote information. This option of zero or no listing allows the summary of the paper tape information without printing all basic output records, thus decreasing the initial processing time. A listing of the basic output records may be obtained from the magnetic storage at some later date.

The magnetic storage tapes contain only the basic output records. These records are written in an unformatted form, or format-free output. Each integer or real variable of a record requires four bytes of magnetic storage, and every character of a literal character string requires one byte, plus four extra computer-required bytes for each record written. The storage requirements for each precipitation record, streamflow, and ground water well are the same: 56 bytes. The magnetic tape is written in blocked records of 100 records per block, and the variable block size (VBS) needed to store the different length records is 6,004 bytes, including four extra bytes per block.

The Fortran IV naming convention must be followed when reading or writing unformatted records on

PRECIPITATION(BREAK POINT BASIC DATA)  
NEWRC,UNIVERSITY PARK,PA.  
STATE-PA. STATE IND. NO.=1600

WATERSHED= MAHANTANGH CR. GAGE=RR44

GAGE NO.	MONTH	DAY	YEAR	TIME HP	MIN	TRACE	PRECIP DEPTH FOR INTERVAL (INCHES)	TYPE	PRECIP ACC. (INCHES)	CODE
TAPE BEGINNING DATE,TIME,READING= 9/ 9/1969 1020 0.0										
RR44	9	17	1969	16	35	T	0.0		0.0	1000
RR44	9	17	1969	16	40		0.2		0.2	1000
RR44	9	17	1969	17	10		0.1		0.3	1000
RR44	9	17	1969	17	25		0.1		0.4	1000
RR44	9	17	1969	17	45		0.1		0.5	1000
RR44	9	17	1969	17	50		0.1		0.6	1000
RR44	9	17	1969	22	45	T	0.0		0.6	1000
RR44	9	17	1969	23	0		0.1		0.7	1000
RR44	9	17	1969	23	50		0.1		0.8	1000
RR44	9	25	1969	13	55		0.1		0.9	1000
RR44	9	27	1969	21	40	T	0.0		0.9	1000
RR44	9	27	1969	22	35		0.1		1.0	1000
RR44	9	28	1969	7	20	T	0.0		1.0	1000
RR44	9	28	1969	7	35		0.1		1.1	1000
RR44	10	2	1969	9	55	T	0.0		1.1	1000
RR44	10	2	1969	10	25		0.1		1.2	1000
RR44	10	2	1969	11	5		0.1		1.3	1000
RR44	10	2	1969	12	5		0.1		1.4	1000
RR44	10	2	1969	13	15	T	0.0		1.4	1000
RR44	10	2	1969	13	35		0.1		1.5	1000
RR44	10	2	1969	14	40	T	0.0		1.5	1000
RR44	10	2	1969	14	45		0.1		1.6	1000
RR44	10	2	1969	15	40		0.1		1.7	1000
RR44	10	2	1969	16	0		0.1		1.8	1000
RR44	10	2	1969	17	10	T	0.0		1.8	1000
RR44	10	2	1969	17	25		0.1		1.9	1000
RR44	10	2	1969	18	30		0.1		2.0	1000
RR44	10	2	1969	19	0		0.1		2.1	1000
RR44	10	2	1969	19	55		0.1		2.2	1000
RR44	10	2	1969	20	55		0.1		2.3	1000
RR44	10	2	1969	23	10	T	0.0		2.3	1000
RR44	10	3	1969	0	10		0.1		2.4	1000
RR44	10	3	1969	1	20	T	0.0		2.4	1000
RR44	10	3	1969	1	25		0.1		2.5	1000
RR44	10	3	1969	2	10		0.1		2.6	1000

END OF TAPE NO.31, FOR GAGE-RR44 END OF TAPE ON LABEL=10/ 7/1969 TIME=11 0 READING= 2.6  
END OF TAPE COMPUTED=10/ 7/1969 TIME=11 0 READING= 2.6

THE NO. OF RECORDS WRITTEN= 44  
THE TOTAL NO. OF PUNCHES FOR PAPER TAPE WAS COMPUTED TO BE= 8073 PUNCH INTERVAL= 5

DATA FOR PAPER TAPE WRITTEN ON TAPE NO.VA1314, FOR STORAGE-- THE ERROR CODE FOR TAPE=1000  
ERROR CODE (1000) GOOD DATA TAPE NO APPARENT ERRORS

Figure 12.--An example of printer output from one precipitation record.



STREAM FLOW (BREAK POINT BASIC DATA) NEWRC, LAIVERSITY PARK, PA.									
STATE-PA. STATE IND. NO.=1606									
WATERSHED= MAHANTANGO CK. GAGE=WE38U									
GAGE NO.	MONTH	DAY	YEAR	TIME HR	TIME MIN	TIME INTR	DISCHARGE TABLE NO.	DEPTH (FT)	CODE
BEGIN OF TAPE LABEL= WE38U									
	10	6	1970	12	50			0.23	1000
FIRST RECORD ON MAG.= WE38U									
	10	6	1970	12	50	12	0	0.23	1000
WE38U	10	6	1970	12	50	12	0	0.23	1000
WE38U	10	6	1970	13	50	24	0	0.22	1000
WE38U	10	6	1970	15	50	46	0	0.21	1000
WE38U	10	6	1970	19	40	52	0	0.20	1000
WE38U	10	6	1970	24	0	203	0	0.20	1000
WE38U	10	7	1970	16	55	85	0	0.19	1000
WE38U	10	7	1970	24	0	123	0	0.19	1000
WE38U	10	8	1970	10	15	54	0	0.20	1000
WE38U	10	8	1970	14	45	111	0	0.19	1000
WE38U	10	8	1970	24	0	117	0	0.19	1000
WE38U	10	9	1970	9	45	53	0	0.20	1000
WE38U	10	9	1970	14	10	118	0	0.19	1000
WE38U	10	9	1970	24	0	70	0	0.19	1000
WE38U	10	10	1970	5	50	204	0	0.20	1000
WE38U	10	10	1970	22	50	14	0	0.19	1000
WE38U	10	10	1970	24	0	27	0	0.19	1000
WE38U	10	11	1970	2	15	261	0	0.20	1000
WE38U	10	11	1970	24	0	203	0	0.20	1000
LAST RECORD ON MAG= WE38U									
	10	11	1970	24	0	1	0	0.20	1000
END OF TAPE NO. 1, FOR GAGE=WE38U									
END OF TAPE ON LABEL=10/12/1970 TIME=17 0 READING= 0.19									
END OF TAPE COMPUTED=10/12/1970 TIME=17 0 READING= 0.19									
THE NO. OF RECORDS WRITTEN= 18									
TOTAL RECORDS WRITTEN ON MAG. TAPE SINCE BEGINNING= 1242									
THE TOTAL NO. OF PUNCHES FOR PAPER TAPE WAS COMPUTED TO BE= 1779 PUNCH INTERVAL= 5									
DATA FOR PAPER TAPE WRITTEN ON TAPE NO.DUMMY, FOR STORAGE-- THE ERROR CODE FOR TAPE=1000									
ERROR CODE=(1000) GOOD DATA TAPE=NO APPARENT ERRORS									

Figure 13.—An example of printer output for one streamflow paper tape record.

AQUIFER DATA(BREAK POINT DATA)								
NEWRC, UNIVERSITY PARK, PA.								
-----								
STATE-PA. STATE IND. NO.=1606								
WATERSHED= MAHANTANGO CK. GAGE=AD37-38								
-----								
ELEVATION REFERENCE=	C.00	BEGIN GAGE HEIGHT=	24.00					
	GAGE	PC	DAY	YEAR	TIME	NREFE	GAGE DEPTH.	CODE
BEGIN CF TAPE LABEL=	AD37-38	4	3	1970	1430	0	24.00	1000
-----								
FIRST RECCRC CN MAG.=	AD37-38	4	3	1970	1430	0	24.03	1000
-----								
	AC37-38	4	3	1970	15 0	0	24.03	1000
	AD37-38	4	3	1970	1530	0	24.03	1000
	AC37-38	4	3	1970	16 0	0	24.03	1000
	AC37-38	4	3	1970	1630	0	24.03	1000
	AC37-38	4	3	1970	17 0	0	24.03	1000
	AC37-38	4	3	1970	1730	0	24.03	1000
	AC37-38	4	3	1970	18 0	0	24.02	1000
	AC37-38	4	3	1970	1830	0	24.01	1000
	AC37-38	4	3	1970	19 0	0	23.98	1000
	AC37-38	4	3	1970	1930	0	23.97	1000
	AD37-38	4	3	1970	20 0	0	23.96	1000
	AD37-38	4	3	1970	2030	0	23.93	1000
	AD37-38	4	3	1970	21 0	0	23.92	1000
	AC37-38	4	3	1970	2130	0	23.91	1000
	AC37-38	4	3	1970	22 0	0	23.90	1000
	AD37-38	4	3	1970	2230	0	23.88	1000
	AC37-38	4	3	1970	23 0	0	23.88	1000
	AC37-38	4	3	1970	2330	0	23.88	1000
	AC37-38	4	3	1970	24 0	0	23.88	1000
	AC37-38	4	4	1970	030	0	23.88	1000
	AC37-38	4	4	1970	1 0	0	23.88	1000
	AC37-38	4	4	1970	130	0	23.88	1000
	AC37-38	4	4	1970	2 0	0	23.88	1000
	AC37-38	4	4	1970	230	0	23.88	1000
	AD37-38	4	4	1970	3 0	0	23.88	1000
	AC37-38	4	4	1970	330	0	23.88	1000
	AD37-38	4	4	1970	4 0	0	23.88	1000
	AC37-38	4	4	1970	430	0	23.88	1000
	AD37-38	4	4	1970	5 0	0	23.88	1000
	AC37-38	4	4	1970	530	0	23.88	1000
	AC37-38	4	4	1970	6 0	0	23.88	1000
	AC37-38	4	4	1970	630	0	23.87	1000
	AC37-38	4	4	1970	7 0	0	23.86	1000
	AC37-38	4	4	1970	730	0	23.84	1000
LAST RECCRC CN MAG.=	AC37-38	4	4	1970	8 0	0	23.81	1000
-----								
ENDING GAGE HEIGHT LABEL= 23.81								
-----								
ENDING CN TAPE LABEL= 4- 4-1970 8 0 23.81								
END OF TAPE COMPUTED= 4- 4-1970 8 0 23.81								
ERROR CODE FOR PAPER TAPE=1000								
35-RECORDS WRITTEN FOR PAPER TAPE								
RECORDS WERE WRITTEN CN MAG. TAPE=DUMMY								
A TOTAL OF - 67RECORDS WERE WRITTEN CN MAG. AT THIS POINT								
ERROR CODE=(1000) GOOD DATA TAPE-NC APPARENT ERRORS								

Figure 14.—An example of printer output from one ground water (aquifer) paper tape record.

magnetic storage tape. The same type, identical first letter, and variable names must be used when reading a record as were used when the record was written on

the magnetic tape. The output variables and storage requirements of each of the three types of hydrologic records are described in the following record layouts:

1. Precipitation data storage records: Record Length = 60 bytes (56 actual + 4 extra).

Variable	IWID	GAGE	NDATE(1)	NDATE(1)	NY11
Storage (Bytes)	4	12	4	4	4
Significant Characters per Field	4	12	2	2	2
	NDATE(3)	NDATE(4)	NDATE(5)	TRACE	DREC.
	4	4	4	4	4
	2	2	2	1	5
	STYPE	NCOD			
	4	4			
	1	4			

2. Streamflow Data Storage Records: Record Length = 60 bytes (56 + 4).

Variable	IWID	GAGE	NDATE(1)	NDATE(2)	NY11	NDATE(3)
Storage (Bytes)	4	12	4	4	4	4
Significant Characters per Field	4	12	2	2	2	2
	NDATE(4)	NDATE(5)	NTINT	NDST	AREC	NCOD
	4	4	4	4	4	4
	2	2	3	1	6	4

3. Ground water well data storage records: Record Length = 60 (56 + 4).

Variable	IWID	GAGE	NDATE(1)	NDATE(2)	NY11	NDATE(3)
Storage (Bytes)	4	12	4	4	4	4
Significant Characters per Field	4	12	2	2	2	2
	NDATE(4)	NDATE(5)	NREFE	AAREC	NCOD	BLANK
	4	4	4	4	4	4
	2	2	1	8	4	0

Variables	Description	Variables	Description
IWID	Watershed Identification number.	NDST	If equal to zero or blank, a large or single streamflow control.
GAGE	Gage location number. Example: (WE38U-----).		If equal to one, a small control of a dual-control gage. Example: (0).
NDATE(1)	Month. Example: (12).	NREFE	If equal to one, the ground water well levels represent elevation. If equal to zero or blank, ground water well levels are actual gage height. Example: (1).
NDATE(2)	Day. Example: (31).		
NY11	First two digits of the year. Example: (19).	DREC	Precipitation amount collected per time interval. Example: (000.2).
NDATE(3)	Last two digits of the year. Example: (72).	AREC	Streamflow level for time. Example: (000.25).
NDATE(4)	Hour (military time). Example: (24).	AAREC	Ground water well level for time. Example: (01985.28).
NDATE(5)	Minutes (multiple of 5 or 30). Example: (00).	NCOD	Gage malfunction ERROR code. Example: (1,000).
TRACE	Trace on or off for record of precipitation. Example: (T).	BLANK	Used as record-padding space (four blanks).
STYPE	The type of precipitation, a blank represents rainfall. Example: (S).		
NTINT	Number of 5-minute intervals streamflow gage level in effect. Example: (101).		

### CONCLUSION

The edited magnetic-tape storage data provide the first step to digital hydrologic data analysis. The data from these storage tapes are retained in the original form as basic data master files. Analysis and data

correction, aided through use of the malfunction error codes, can be accomplished from the master files at the discretion of the user.

## APPENDIX 1. GAGE MALFUNCTION ERROR CODES

A ONE IN COLUMN ONE MEANS VALUE PUNCHED ON LAST PUNCH  
OUT OF PAPER TAPE IS TRUE VALUE RECORDED BY GAGE. A ZERO  
IN COLUMN ONE MEANS AN ERROR IN LAST VALUE PUNCHED.

A 'X' NOTES A CHOICE OF A '1' OR A '0' IN COLUMN ONE.

1000=GOOD DATA TAPE NO APPARENT ERRORS

2000=DATA CONTAINS ESTIMATED VALUES OR (ESTIMATED DATA)

### ( TIME LOSS CODES )

X010 = TIME LOSS-TIMER FAILURE GAGE STOPPED  
X011 = TIME LOSS-LEAF SWITCH FAILURE GAGE RAN CONTINUOUSLY UNTIL BATTERY FAILED  
X012 = TIME LOSS-TIMER FAILURE INTERMITTANT OPERATION  
X013 = TIME LOSS-TIMER FAILURE TIME DIFFERENCE AT END OF PAPER TAPE.  
X014 = TIME LOSS-  
X015 = TIME LOSS-  
X016 = TIME LOSS-  
X017 = TIME LOSS-  
X018 = TIME LOSS-  
X019 = TIME LOSS-  
X020 = TIME LOSS-NO APPARENT REASON  
X021 = TIME LOSS-  
X022 = TIME LOSS-LEAF SWITCH FAILURE  
X023 = TIME LOSS-BATTERY FAILURE  
X024 = TIME LOSS-IMPROPER TAPE INDEXING  
X025 = TIME LOSS-PUNCH MOTOR OPERATES INTERMITTANTLY  
X026 = TIME LOSS-PUNCH MOTOR FAILURE  
X027 = TIME LOSS-  
X028 = TIME LOSS-  
X029 = TIME LOSS-

### ( TIME GAIN CODES )

X030 = TIME GAIN-TIMER FAILURE 2 1/2 MINUTE PUNCH INTERVAL  
X031 = TIME GAIN-TIMER FAILURE INTERMITTANT OPERATION  
X032 = TIME GAIN-LEAF SWITCH FAILURE GAGE RAN CONTINUOUSLY UNTIL BATTERY FAILED  
X033 = TIME GAIN-NO APPARENT REASON  
X034 = TIME GAIN-LEAF SWITCH FAILURE  
X035 = TIME GAIN-IMPROPER TAPE INDEXING  
X036 = TIME GAIN-TIMER FAILED TIME DIFFERENCE AT END OF TAPE  
X037 = TIME GAIN-  
X038 = TIME GAIN-

X039 = TIME GAIN-  
X040 = TIME GAIN-  
X041 = TIME GAIN-  
X042 = TIME GAIN-  
X043 = TIME GAIN-  
X044 = TIME GAIN-  
X045 = TIME GAIN-  
X046 = TIME GAIN-  
X047 = TIME GAIN-  
X048 = TIME GAIN-  
X049 = TIME GAIN-

( INCOMPLETE RECORD, IMPROPER PUNCHING, SENSITIVITY  
CODES)

X050 = TAPE IMPROPERLY INDEXED ( NO TIME LOSS OR GAIN )  
X051 = GAGE INSENSITIVE AT SOME POINT ON RECORD  
X052 = SNOW WITH FUNNEL IN PLACE  
X053 = INTAKE SILT PROBLEM  
X054 = INTAKE PIPE STOPPED UP  
X055 = DRIFTING SNOW  
X056 = FOREIGN MATTER IN COLLECTOR  
X057 = CABLE BREAKAGE  
X058 = GAGE TAMPERED WITH  
X059 = FUNNEL FALLEN IN COLLECTOR  
X060 = PRECIPITATION LOSS NO REASON  
X061 =  
X062 =  
X063 =  
X064 =  
X065 =  
X066 =  
X067 = PAPER TAPE SUPPLY RAN OUT  
X068 = TIMER TURNED TO TEST POSITION  
X069 =  
X070 = NOTCH OF WEIR PROBLEM (ICE)  
X071 = LOG JAMS OR BEBRE IN NOTCH  
X072 = VALUE GREATER THAN RANGE OF INSTRUMENT AT SOME POINT  
X073 = FLOAT TAPE DISENGAGED FROM RECORDER  
X074 =  
X075 =  
X076 =  
X077 =  
X078 = ICE JAMMING ( CAUSE HIGH G H )  
X079 = HEAVY ICED CREEK

( TRACE INDICATOR MALFUNCTIONS )

NOTE IF TRACE CODE USED OR COMBINATION OF TRACE CODE USED PL  
ACE A 1 IN COLUMN 55 OF PAPER TAPE IDENTIFICATION FORM  
X080 = TRACE PUNCHES WITHOUT PRECIPITATION  
X081 = PRECIPITATION WITHOUT TRACE PUNCHES

X082 = TRACE INCONSISTENT  
X083 =  
X084 =  
X085 =  
X086 =  
X087 =  
X088 =  
X089 =

( TRANSLATOR READING ERRORS )

X090 = TRANSLATOR READ HEAD MALFUNCTION ( INCORRECT RECORD )  
X091 = MANUALLY INSERTED READING ON DOUBLE PUNCHES WRONG  
X092 =  
X093 =  
X094 =  
X095 =  
X096 =  
X097 =  
X098 =  
X099 =

( COMPLEX ERROR CODES )

X100 = X024+X026 TIME LOSS IMPROPER INDEXING & PUNCH MOTOR FAILURE  
X101 = X035+X026 TIME GAIN IMPROPER INDEXING & MOTOR FAILURE  
X102 = X026+X080 MOTOR FAILURE & TRACE WITHOUT PRECIPITATION  
X103 = X020+X082 TIME LOSS NO REASON & TRACE INCONSISTANT  
X104 = X033+X082 TIME GAIN NO REASON & TRACE INCONSISTANT  
X105 = X023+X024 BATTERY FAILED & TIME LOSS TAPE INDEXING  
X106 = X023+X035 BATTERY FAILED & TIME GAIN TAPE INDEXING  
X107 = X050+X082 TAPE IMPROPER INDEXED & TRACE INCONSISTANT  
X108 = X020+X080 TIME LOSS NO APPARENT REASON & TRACE WITHOUT PRECIPITATION  
X109 = X033+X080 TIME GAIN NO APPARENT REASON & TRACE WITHOUT PRECIPITATION  
X110 = X023+X026 BATTERY FAILURE & PUNCH MOTOR FAILURE  
X111 = X024+X081 TIME LOSS IMPROPER INDEXING & PRECIPITATION WITHOUT TRACE  
X112 = X035+X081 TIME GAIN IMPROPER INDEXING & PRECIPITATION WITHOUT TRACE  
X113 = X024+X082 TIME LOSS IMPROPER INDEXING & TRACE INCONSISTANT.  
X114 = X035+X082 TIME GAIN IMPROPER INDEXING & TRACE INCONSISTANT.  
X115 = X012+X051 TIME LOSS TIMER INTERMITTANT & GAGE INSENSITIVE AT A POINT  
X116 = X031+X051 TIME GAIN TIMER INTERMITTANT & GAGE INSENSITIVE AT A POINT  
X117 = X070+X054 NOTCH OF WEIR ICE & INTAKE PIPE STOPPED UP  
X118 = X060+X050 PRECIPITATION LOSS NO REASON & TAPE IMPROPE

R INDEXING.

X119 = X013+X052+X055 TIME LOSS TIMER FAILURE & SNOW WITH FUNNEL & DRIFTING SNOW

X120 = X036+X052+X055 TIME GAIN TIMER FAILURE & SNOW WITH FUNNEL & DRIFTING SNOW

X121 = X024+X052 TIME LOSS IMPROPER TAPE INDEXING & SNOW WITH FUNNEL IN PLACE.

X122 = X035+X052 TIME GAIN IMPROPER TAPE INDEXING & SNOW WITH FUNNEL IN PLACE.

X123 = X024+X057 TIME LOSS IMPROPER TAPE INDEXING & CABLE BREAKAGE

X124 = X035+X057 TIME GAIN IMPROPER TAPE INDEXING & CABLE BREAKAGE

X125 = X052+X055 SNOW WITH FUNNEL & DRIFTING SNOW

X126 = X026+X052 PUNCH MOTOR FAILURE & SNOW WITH FUNNEL IN

X127 = X013+X080 TIME LOSS TIMER FAILURE & TRACE WITHOUT PRECIPITATION.

X128 = X036+X080 TIME GAIN TIMER FAILURE & TRACE WITHOUT PRECIPITATION.

X129 = X026+X030 PUNCH MOTOR FAILURE & TIMER FAILED 2 1/2 MINUTE PUNCH OUT

X130 = X081+X050 PRECIPITATION WITHOUT TRACE & TAPE IMPROPERLY INDEXED

X131 = X091+X024 TRANSLATOR READ HEAD MALFUNCTION & TIME LOSS TAPE INDEXING.

X132 = X091+X035 TRANSLATOR READ HEAD MALFUNCTION & TIME GAIN TAPE INDEXING.

X133 = X072+X073 VALUE GREATER THAN RANGE & FLOAT TAPE DISENGAGED.

X134 = X033+X081 TIME GAIN NO APPARENT REASON AND PRECIP. WITHOUT TRACE.

X135 =

X136 =

X137 =

X138 =

X139 =

X140 =

X141 =

X142 =

X143 =

X144 =

X145 =

X146 =

X147 =

X148 =

X149 =

X150 =

X151 =

X152 =

X153 =

X154 =



X155 =  
X156 =  
X157 =  
X158 =  
X159 =  
X160 =  
X161 =  
X162 =  
X163 =  
X164 =  
X165 =  
X166 =  
X167 =  
X168 =  
X169 =  
X170 =  
X171 =  
X172 =  
X173 =  
X174 =  
X175 =  
X176 =  
X177 =  
X178 =  
X179 =  
X180 =  
X181 =  
X182 =  
X183 =  
X184 =  
X185 =  
X186 =  
X187 =  
X188 =  
X189 =  
X190 =  
X191 =  
X192 =  
X193 =  
X194 =  
X195 =  
X196 =  
X197 =  
X198 =  
X199 =

---

---

---

# APPENDIX II. COMPUTER SOURCE PROGRAM LISTING.

```

LOGICAL*1 WSH(16),HCARD1(54),HCARD2(54),HCARD3(54)
LOGICAL*1 OUT2(6),ACARD(80)
COMMON OUT2,ACARD
COMMON/BLK1/STYPE(999),AREC(257),CREC(257),ATRA(257),C
1TRA(257), GAGE(3),GAG(3),NSDTE(999,3),NDATE(257,5)
COMMON/BLK2/J,I,L,NSTOP,NCHECK,NSTORE,ISTORE,ICHECK,NI
1CE, NWSH,KSEQ,NSEQ,NOTE,MIAC,NSKIP,NLIST,NPFG,
2NOPT,NCPT,NIPT,NTYPE,NX,KB,IX,MAXNO,IEOF,NOEOF,NCOD,IT
3,KT,NSTART,LDATA,ELEREF,NSC,YACC,ACC,NTRACE,ABASE,NSNO
4W,INDEX,NGO,NEED,NUT,ATREC,BTREC,ITIC ,NDST,
5NTINT,LTINT,NORM,LHEC,DREC,NTIC,ADIFF,NFIRST,NREFE,NPI
6L
COMMON/BLK3/NH1,NY22,NMIN,IYR,MT1,NM1,NY2,NMONTH,IHR,N
1D1,ARD1,NH2,NDAY,IMO,IMN,NY11,MT2,NM2,NYEAR,IDA,NY1,ND
22,ARD2,NHOUR,NYE,NYXX, ITMO,ITDA,ITYR,ITHR,ITMN,GREF,
3MASH,NDEX,KTMO,KTDA,KTY,KTYR,KTHR, KTMN,NSTARE,IY,ARE
4D,MTINT,IWID
COMMON/BLK4/LLL(12)/BLK5/TR(2)
CALL ERRSET (215,256,-1,1,1)
NFILE=1
NCPT=0
NSEQQ=0
5001 KSEQ=0
C INITIALIZING OF STORAGE
DO 1 L=1,257
DO 1 I=1,5
ATRA(L)=0.0
AREC(L)=00.00
CTRA(L)=0.0
CREC(L)=00.00
1 NDATE(L,I)=00
DO 55 I=1,999
DO 55 K=1,3
55 NSDTE(I,K)=00
NSTORE=0
NOTE=0
NSTOP=0
NSEQ=0
NSNOW=0
ATREC=0.0
BTREC=0.0
KB=0
NREFE=0
NORM=0

```

```

C READ HEADER CARD FOR NUMBER OF PAGE HEADING CARDS
  READ(5,152) NHEAD,NSC
152 FORMAT(11,13)
C READ PAGE HEADING CARDS
  IF(NHEAD.EQ.0) GO TO 5002
  READ(5,5003) HCARD1
5003 FORMAT(54A1)
  IF(NHEAD.EQ.1) GO TO 5002
  READ(5,5003) HCARD2
  IF(NHEAD.EQ.2) GO TO 5002
  READ(5,5003) HCARD3
5002 CONTINUE
C X X X X SNOW CARDS READ IF NSC GT ZERO AND PRECIP DATA
  IF(NSC.EQ.0) GO TO 3
  DO 151 I=1,NSC
  READ(5,2)(NSDTE(I,L),L=1,3),STYPE(I)
2    FORMAT(3I2,A1)
151 CONTINUE
3    NOPT=0
    NCHECK=0
    INDEX=1
    YACC=0.0
    NEED=0
    IX=0
    NSTART=0
    IF(NSC.EQ.0) NSC=1
C X X X X X CONTROL CARD READ
  READ(5,4)STATE,IWID,WSH,GAG ,NPFG,NTPT,IEOF,IT,KT,OUT2
  1,NSKIP,NOEOF,KT1,KT2,KT3,KT4,NDST,NEWDAT,IGREF
4    FORMAT(A3,I4,16A1, 3A4,2I2,I1,2I2,6A1,I1,5I2,2I1,I4)
C X X X X X X X X X LABEL CARD READ X X X X X X X X X
5  READ(5,6) NCOD,GAGE,NPIL,NTYPE,NTRACE,MT1,ND1,NY11,NY1
  1,NH1,NM1,ARD1,MT2,ND2,NY22,NY2,NH2,NM2,ARD2,ICHECK,NLI
  2ST,ITCHG,LDATA,ELEREF
6    FORMAT(I4, 3A4,I2,2I1,2(6I2,F4.2),4I1,F6.2)
    AGRF=IGREF
    IF(NTYPE.EQ.1) GREF=AGREF*.1
    IF(NTYPE.EQ.2.OR.NTYPE.EQ.3) GREF=AGREF*.01
    IF(IGREF.EQ.0.AND.NTYPE.EQ.1) GREF=001.0
    IF(IGREF.EQ.0.AND.NTYPE.EQ.2) GREF=30.00
    IF(IGREF.EQ.0.AND.NTYPE.EQ.3) GREF=60.00
    IF(IGREF.EQ.0.AND.NTYPE.EQ.3.AND.ELEREF.GT.0.0) GREF=E
    1LEREF+60.00
    MIAC=1
    IF(ITCHG.EQ.1) NTRACE=0
C X X X X X X X CHECKING FOR PROPER DATA TYPE AND WRITING HEA
C DINGS
  DO 992 MN=1,3
  IF(GAGE(MN).EQ.GAG(MN)) GO TO 992
  GO TO 991

```

```

992 CONTINUE
      GO TO 8
991 WRITE(6,7)
7 FORMAT(' STOPPED WRONG TYPE DATA OR GAGE NAMES DO NOT
      1MATCH')
      GO TO 3000
8 WRITE(6,5004)
5004 FORMAT(1H1)
      IF(NHEAD.EQ.0) GO TO 5006
      WRITE(6,5005)HCARD1
5005 FORMAT(37X,54A1)
      IF(NHEAD.EQ.1) GO TO 5006
      WRITE(6,5005)HCARD2
      IF(NHEAD.EQ.2) GO TO 5006
      WRITE(6,5005)HCARD3
5006 WRITE(6,9) STATE,IWID,WSH,GAGE
9 FORMAT(37X,'STATE-',A3,5X,'STATE IND. NO.=',I4//37X,
1 'WATERSHED=',I6A1,5X,'GAGE=', 3A4//)
      NICE=0
      NOTE=0
      NWSH=0
      NYE=NY11
      NMONTH=MT1
      NDAY=ND1
      NYEAR=NY1
      NHOOR=NH1
      NMIN=NM1
      NX=0
      IMD=MT2
      IDA=ND2
      IY=NY22
      IYR=NY2
      IHR=NH2
      IMN=NM2
      ARED=ARD2
      NUT=0
      ACC=0.0
      NSTARE=0
      ISTORE=0
      ITIC=0
      NEED=0
      NGO=0
      NFIRST=1
      IF(ICHECK.EQ.0) GO TO 14
C X X X X X X X X READ TRANSLATOR ERROR CARD
      READ(5,31) IMO,IDA,IY,IYR,IHR,IMN,ARED
31 FORMAT(36X,6I2,F4.2)
14 IF(NSTORE.EQ.0) GO TO 15
C X X X X X X X X TAKE OUT OF STORAGE DATA STORED FROM LAS
C T READ

```

```

DO 101 J=1,MAXNO
AREC(J)=CREC(KB)
IF(NTYPE.NE.1) GO TO 101
ATRA(J)=CTRA(KB)
101 KB=KB+1
J=MAXNO
GO TO 103
C X X X X X X X X X INPUT DATA READ OF MAG. TAPE
C X X X X X X X X X TEST FOR FOUR NINES END OF TAPE
15 DO 150 J=1,255
IF(NTYPE.EQ.1) GO TO 9002
READ(IT,10,END=200,ERR=9000) AREC(J)
10 FORMAT(F4.2)
IF(IEOF.EQ.1) GO TO 150
9001 IF(AREC(J).EQ.99.99) GO TO 104
GO TO 150
9000 READ(IT,10,END=200,ERR=9001) AREC(J)
IF(IEOF.EQ.1) GO TO 150
GO TO 9001
9002 READ(IT,99,END=200,ERR=9003) ATRA(J),AREC(J)
99 FORMAT(F1.0,F3.1)
IF(IEOF.EQ.1) GO TO 150
9004 IF(AREC(J).EQ.99.9.AND.ATRA(J).EQ.9.) GO TO 104
GO TO 150
9003 READ(IT,99,END=200,ERR=9004) ATRA(J),AREC(J)
IF(IEOF.EQ.1) GO TO 150
GO TO 9004
150 CONTINUE
C X X X X X X X X X CONTINUE NOT END OF PAPER TAPE
J=255
103 NSTORE=0
NCHECK=0
NOTE=0
13 CALL DATIME
GO TO 11
C X X X X X X X X X END OF PAPER TAPE STEP PAPER TAPE COUNT
C
104 NCPT=NCPT+1
NOPT=NOPT+1
NOTE=1
NSTORE=0
NCHECK=1
NX=1
IF(J.EQ.1) GO TO 110
NX=0
J=J-1
CALL DATIME
11 IF(NORM.EQ.1) GO TO 12
GO TO 110
12 CALL CHECKO

```

```

      IF(NSTOP.EQ.1) GO TO 3000
      GO TO 110
C X X X X X X X X X X READ END OF FILE BRANCH ON DATA READ
200  NCPT=NCPT+1
      NOPT=NOPT+1
      NSTOP=0
      NSTORE=0
      NCHECK=1
      NOTE=1
      IF(J.EQ.1) GO TO 13
      J=J-1
      GO TO 13
C X X X X X X X X X X TEST TO SEE IF END OF ALL PAPER TAPES FO
C      R A GAGE,OR
C X X X X X X X X X X END OF ALL PAPER TAPES FOR THE RUN
110  IF(NOPT.EQ.NPFG) NWSH=1
      IF(NCPT.EQ.NTPT) NSTOP=1
      LTINT=0
      IF(NX.EQ.1) GO TO 311
      NX=0
      IF(NTYPE.LT.1.OR.NTYPE.GT.3) GO TO 991
      IF(NTYPE.EQ.1) CALL PRECIP
      IF(NTYPE.EQ.2) CALL RUNOFF
      IF(NTYPE.EQ.3) CALL AQUFER
311  NSTARE=1
      NICE=1
      IF(NCHECK.EQ.1) NSTARE=0
      IF(NCHECK.EQ.1) GO TO 28
      GO TO 15
28   CALL OUTPUT
      IF(NSTOP.EQ.1) GO TO 32
      IF(NWSH.EQ.1.AND.NEWDAT.EQ.1) GO TO 32
      IF(NWSH.EQ.1) GO TO 3
      GO TO 5
C X X X X X X X X X X END OF PROGRAM WRITE INFO ABOUT TAPE SE
C      PERATERS
32   NSEQQ=NSEQQ+NSEQ
      IF(IEOF.EQ.0) GO TO 51
      WRITE(6,50)
50   FORMAT(' INPUT PAPER TAPES WHERE SEPERATED BY EOFS')
      GO TO 500
51   WRITE(6,53)
53   FORMAT(' INPUT PAPER TAPES WHERE SEPERATED BY FOUR-NIN
      IES')
500  IF(NEWDAT.EQ.0) GO TO 501
      WRITE(6,452) NSEQ,NFILE
452  FORMAT(1H0,'TOTAL RECORDS WRITTEN ON MAG. TAPE=',I6,'
      1FOR TAPE FILE NO.',I3)
      IF(NSKIP.EQ.1) GO TO 5001
      NFILE=NFILE+1

```

```

END FILE KT
GO TO 5001
501 WRITE(6,451)NSEQQ
451 FORMAT(1H0,'TOTAL NO. RECORDS WRITTEN ON MAG. TAPE=',I
16)
IF(KT1.NE.0) END FILE KT1
IF(KT2.NE.0) END FILE KT2
IF(KT3.NE.0) END FILE KT3
IF(KT4.NE.0) END FILE KT4
3000 STOP
END
SUBROUTINE DATIME
C SUBR. COMPUTES DATE AND TIME FOR EACH RECORD READ IN
LOGICAL*1 OUT2(6),ACARD(80)
COMMON OUT2,ACARD
COMMON/BLK1/STYPE(999),AREC(257),CREC(257),ATRA(257),C
1TRA(257), GAGE(3),GAG(3),NSDTE(999,3),NDATE(257,5)
COMMON/BLK2/J,I,L,NSTOP,NCHECK,NSTORE,ISTORE,ICHECK,NI
1CE, NWSH,KSEQ,NSEQ,NOTE,MIAC,NSKIP,NLIST,NPFG,
2NOPT,NCPT,NTPT,NTYPE,NX,KB,IX,MAXNO,IECF,NOECF,NCOD,IT
3,KT,NSTART,LDATA,ELEREF,NSC,YACC,ACC,NTRACE,ABASE,NSNO
4W,INDEX,NGO,NEED,NUT,ATREC,BTREC,ITIC ,NDST,
5NTINT,LTINT,NORM,LHEC,DREC,NTIC,ADIFF,NFIRST,NREFE,NPI
6L
COMMON/BLK3/NH1,NY22,NMIN,IYR,MT1,NM1,NY2,NMONTH,IHR,N
1D1,ARD1,NH2,NDAY,IMO,IMN,NY11,MT2,NM2,NYEAR,IDA,NY1,ND
22,ARD2,NHOUR,NYE,NYXX, ITMO,ITDA,ITYR,ITHR,ITMN,GREF,
3MASH,NDEX,KTMO,KTDA,KTY,KTYR,KTHR, KTMN,NSTARE,IY,ARE
4D,MTINT,IWID
COMMON/BLK4/LLL(12)/BLK5/TR(2)
C X X X X X X LEAP YEAR TEST X X X X X X X X X X X X
LLL(2)=28
IF(NYEAR.EQ.00.AND.NYE.NE.20) GO TO 11
IF(NYEAR.EQ.00.AND.NYE.NE.20) GO TO 11
IF((NYEAR/4*4).EQ.NYEAR) LLL(2)=29
C X X X X X X X X FILLING ARRAY WITH DATE TIME OF EACH GAG
C E HEIGHT
11 IF(J.EQ.256) J=J-1
DO 13 I=1,J
NDATE(I,1)=NMONTH
NDATE(I,2)=NDAY
NDATE(I,3)=NYEAR
NDATE(I,4)=NHOURL
NDATE(I,5)=NMIN
IF(NCOD.NE.1000.AND.ICHECK.EQ.0) GO TO 446
IF((IMO.EQ.NMONTH).AND.(IDA.EQ.NDAY).AND.(IYR.EQ.NYEAR
1).AND.(IHR.EQ.NHOUR).AND.(IMN.EQ.NMIN)) GO TO 107
446 IF((NMONTH.EQ.12).AND.(NDAY.EQ.31).AND.(NHOUR.EQ.24))
1GO TO 12
NMIN=NMIN+NPIL

```

```

MIAC=MIAC+1
IF(NMIN.NE.60) GO TO 34
NHOURL=NHOURL+01
NMIN=00
34 IF((NHOURL.EQ.24).AND.(NMIN.EQ.00)) GO TO 13
IF(NHOURL.LT.24) GO TO 13
NDAY=NDAY+01
NHOURL=00
K=NMONTH
IF(NDAY.LE.LLL(K)) GO TO 13
NMONTH=NMONTH+01
NDAY=01
GO TO 13
12 NMONTH=01
NDAY=01
NYEAR=NYEAR+01
LLL(2)=28
IF(NYEAR.EQ.00.AND.NYE.NE.20) GO TO 1001
IF((NYEAR/4*4).EQ.NYEAR) LLL(2)=29
1001 IF(NYEAR.NE.100) GO TO 20
NYEAR=00
NY11=NY11+1
NY22=NY22+1
20 NHOURL=00
NMIN=NPIL
13 CONTINUE
NORM=0
GO TO 108
107 NORM=1
108 RETURN
END

SUBROUTINE CHECKO
C SUBR. FINDS END OF PAPER TAPE IF ICHECK CODE IS USED AND
C A ERROR HAS OCURRED
LOGICAL*1 OUT2(6),ACARD(80)
COMMON OUT2,ACARD
COMMON/BLK1/STYPE(999),AREC(257),CREC(257),ATRA(257),C
1TRA(257), GAGE(3),GAG(3),NSDTE(999,3),NDATE(257,5)
COMMON/BLK2/J,I,L,NSTOP,NCHECK,NSTORE,ISTORE,ICHECK,NI
1CE, NWSH,KSEQ,NSEQ,NOTE,MIAC,NSKIP,NLIST,NPFG,
2NOPT,NCPT,NTPT,NTYPE,NX,KB,IX,MAXNO,IEOF,NOEOF,NCOD,IT
3,KT,NSTART,LDATA,ELEREF,NSC,YACC,ACC,NTRACE,ABASE,NSNO
4W,INDEX,NGO,NEED,NUT,ATREC,BTREC,ITIC ,NDST,
5NTINT,LTINT,NORM,LHEC,DREC,NTIC,ADIFF,NFIRST,NREFE,NPI
6L
COMMON/BLK3/NH1,NY22,NMIN,IYR,MT1,NM1,NY2,NMONTH,IHR,N
1D1,ARD1,NH2,NDAY,IMO,IMN,NY11,MT2,NM2,NYEAR,IDA,NY1,ND
22,ARD2,NHOURL,NYE,NYXX, ITMO,ITDA,ITYR,ITHR,ITMN,GREF,
3MASH,NDEX,KTMO,KTDA,KTY,KTYR,KTHR, KTMN,NSTARE,IY,ARE
4D,MTINT,IWID

```



COMMON/BLK4/LLL(12)/BLK5/TR(2)

C \* \* \* CHECK TO SEE IF PAPER TAPE SEPERATORS EOFS OR 4 NINE  
C S

NPEXT=0

IF(IEOF.EQ.1) GO TO 205

C X X X X X X X X X TESTING TO SEE IF END OF PAPER TAPE CONT  
C ROL FOUR

C X X X X X X X X -NINES WAS LEFT OUT OR DIFFERENT(SEE ICH  
C ECK)

107 IF(NOTE.EQ.0) GO TO 100

C FOUND 4 NINES

108 IF(ICHECK.EQ.2) GO TO 116

IF(ICHECK.GT.5) GO TO 125

118 J=I

NSTORE=0

GO TO 110

116 IF(NTYPE.EQ.1) GO TO 9004

READ(IT,10,END=201,ERR=9001) EREC

10 FORMAT(F4.2)

120 IF(IEOF.EQ.1) GO TO 109

IF(EREC.EQ.99.99) GO TO 118

C X X X X X X X X STORE DATA FOR NEXT PAPER TAPE

109 NSTORE=1

IF(NTYPE.EQ.1) CTRA(1)=ETRA

CREC(1)=EREC

MAXND=1

J=I

K8=1

GO TO 110

9004 READ(IT,99,END=201,ERR=9005) ETRA,EREC

99 FORMAT(F1.0,F3.1)

9006 IF(IEOF.EQ.1) GO TO 109

IF(EREC.EQ.99.9.AND.ETRA.EQ.9.) GO TO 118

GO TO 109

9005 READ(IT,99,END=201,ERR=9004) ETRA,EREC

GO TO 9006

9001 READ(IT,10,END=201,ERR=116 ) EREC

GO TO 120

100 NCPT=NCPT+1

NOPT=NOPT+1

NCHECK=1

IF(NPEXT.EQ.1) GO TO 108

NEDR=0

I2=J-1

J=1

IF(I2.EQ.0) NEDR=1

IF(NEDR.EQ.1) I2=255

I1=I+1

IF(NEDR.EQ.1) I1=1

KEND=I1+(I2-1)

```

      NKK=0
      NCC=0
      IKK=0
      IF(NEDR.EQ.0) GO TO 170
      GO TO 190
170   DO 171 KP=11,KEND
      IF(NTYPE.EQ.1) CTRA(KP)=ATRA(KP)
171   CREC(KP)=AREC(KP)
C     NEED TO READ TAPE INTO MREC ARRAY IF(NEDR=1) GO TO 190
179   DO 180 KX=11,KEND
      IF(IEOF.EQ.1) GO TO 111
      IF(NTYPE.EQ.1) GO TO 9007
      IF(CREC(KX).EQ.99.99) GO TO 182
9008  IF(CREC(KX).EQ.00.0) GO TO 180
112   NKK=1
      GO TO 184
111   IF(EREC.EQ.00.0) GO TO 180
      GO TO 112
9007  IF(CREC(KX).EQ.99.9.AND.CTRA(KX).EQ.9.) GO TO 182
      GO TO 9008
180   CONTINUE
      NEDR=1
      IKK=IKK+1
      IF(IKK.EQ.5) GO TO 125
174   I1=1
      KEND=255
      GO TO 190
182   IF(ICHECK.EQ.2) GO TO 183
      IF(KX.EQ.KEND) GO TO 199
188   MAXNO=KEND-KX
      KB=KX+1
189   NSTORE=1
      GO TO 110
184   IF(KX.EQ.KEND) GO TO 173
      KV=KX+1
192   IF(IEOF.EQ.1) GO TO 186
      IF(NTYPE.EQ.1) GO TO 9009
      IF(CREC(KV).EQ.99.99) GO TO 172
186   IF(KV.EQ.KEND) GO TO 187
      KV=KV+1
      GO TO 192
9009  IF(CREC(KV).EQ.99.9.AND.CTRA(KV).EQ.9.) GO TO 172
      GO TO 186
187   MAXNO=KEND-(KX-1)
      KB=KX
      IF(ICHECK.EQ.3) GO TO 188
      GO TO 189
172   MAXNO=KEND-KV
      KB=KV+1
      GO TO 189

```

```

173  CREC(1)=CREC(KX)
      IF(NTYPE.EQ.1) CTRA(1)=CTRA(KX)
      I1=2
      KEND=255
190  DO 191 KX=I1,KEND
      IF(NTYPE.EQ.1) GO TO 9010
      READ(IT,10,END=201,ERR=9002) CREC(KX)
      GO TO 191
9010 READ(IT,99,END=201,ERR=9011) CTRA(KX),CREC(KX)
      GO TO 191
9011 READ(IT,99,END=201) CTRA(KX),CREC(KX)
      GO TO 191
9002 READ(IT,10,END=201) CREC(KX)
191  CONTINUE
      GO TO 179
183  NCC=NCC+1
      IF(KX.EQ.KEND) GO TO 174
      IF(NCC.EQ.2) GO TO 188
      I1=KX+1
      GO TO 179
199  NSTORE=0
      GO TO 110
125  WRITE(6,126)
126  FORMAT(' UNABLE TO DETERMINE END OF PAPER TAPE---STOPP
1ED')
      NSTOP=1
      GO TO 110
C X X X END OF FILES USED AS TAPE SEPERATORS
205  IF(NOTE.EQ.1) GO TO 108
      IF(ICHECK.EQ.2) GO TO 206
      GO TO 100
206  DO 207 KXE=1,255
      IF(NTYPE.EQ.1) GO TO 9012
      READ(IT,10,END=203,ERR=9003) CREC(KXE)
      GO TO 207
9012 READ(IT,99,END=203,ERR=9013) CTRA(KXE),CREC(KXE)
      GO TO 207
9013 READ(IT,99,END=203) CTRA(KXE),CREC(KXE)
      GO TO 207
9003 READ(IT,10,END=203) CREC(KXE)
207  CONTINUE
      MAXNO=255
      KB=1
      NSTORE=1
      J=1
      GO TO 110
C X X X BRANCH ON END OF FILE FROM EOF SEPERATORS
203  NPEXT=1
      GO TO 100
C X X X X X X X X X X READ END OF FILE BRANCH ON (ICHECK ROUTI

```

```

C      NE READ)
201    NSTOP=0
202    NCHECK=1
      NSTORE=0
      NOTE=1
      GO TO 118
110    RETURN
      END
      SUBROUTINE PRECIP
      LOGICAL*1 OUT2(6),ACARD(80)
      COMMON OUT2,ACARD
      COMMON/BLK1/STYPE(999),AREC(257),CREC(257),ATRA(257),C
1TRA(257), GAGE(3),GAG(3),NSDTE(999,3),NDATE(257,5)
      COMMON/BLK2/J,I,L,NSTOP,NCHECK,NSTORE,ISTORE,ICHECK,NI
1CE, NWSH,KSEQ,NSEQ,NOTE,MIAC,NSKIP,NLIST,NPFG,
2NOPT,NCPT,NTPT,NTYPE,NX,KB,IX,MAXNO,IECF,NOEOF,NCOD,IT
3,KT,NSTART,LDATA,ELEREF,NSC,YACC,ACC,NTRACE,ABASE,NSNO
4W,INDEX,NGO,NEED,NUT,ATREC,BTREC,ITIC ,NDST,
5NTINT,LTINT,NORM,LHEC,DREC,NTIC,ADIFF,NFIRST,NREFE,NPI
6L
      COMMON/BLK3/NH1,NY22,NMIN,IYR,MT1,NM1,NY2,NMONTH,IHR,N
1D1,ARD1,NH2,NDAY,IMO,IMN,NY11,MT2,NM2,NYEAR,IDA,NY1,ND
22,ARD2,NHOUR,NYE,NYXX, ITMO,ITDA,ITYR,ITHR,ITMN,GREF,
3MASH,NDEX,KTMO,KTDA,KTY,KTYR,KTHR, KTMN,NSTARE,IY,ARE
4D,MTINT,IWID
      COMMON/BLK4/LLL(12)/BLK5/TR(2)
      IF(NICE.EQ.1) GO TO 229
      WRITE(6,201)
201    FORMAT(26X,'GAGE',7X,'MONTH DAY YEAR',4X,
3'TIME TRACE PRECIP DEPTH TYPE PRECIP CODE'/
126X,' NO.',27X,'HR MIN FOR INTERVAL
2 ACC.'/77X,'(INCHES) (INCHES)'/)
C X X X X X X X X X WRITE BEGINNING DATE TIME GAGE HEIGHT IF
C THE FIRST
C X X X X X X X X X READING OF A PAPER TAPE
      BRD1=ARD1*10.0
      WRITE(6,46) MT1,ND1,NY11,NY1,NH1,NM1,BRD1
46    FORMAT(37X,'PAPER TAPE BEGINNING DATE,TIME,READING=',I
12,'/',I2,'/',2I2,3X,I2,I2,2X,F4.1/)
C X X X X X X X X X ROUTINE TO EDIT OUT EXTRANEQUS READINGS,
C WRITE ON MAG
      NTIC=0
      NSNOW=0
      IF(J.EQ.1) GO TO 311
      I=3
      GO TO 306
229    I=1
306    IF(NSTARE.EQ.1) GO TO 307
      ABASE=AREC(I)
307    IF(NTRACE.EQ.1) GO TO 350

```

```

C
C
C X X X X X X X TRACE OUT ROUTINE
      IF(AREC(I).LE.ABASE) GO TO 313
      KIX=I+1
      NJOE=1
      IF(KIX.EQ.J) GO TO 400
      IF(AREC(KIX).EQ.ABASE) GO TO 401
400    ADIFF=AREC(I)-ABASE
      IF(ADIFF.GT.GREF) GO TO 313
310    IF(NSNOW.EQ.1) GO TO 309
      MASH=1
316    DO 317 INDEX=1,NSC
      IF(NDATE(I,1).EQ.NSDTE(INDEX,1).AND. NDATE(I,2).EQ.NSD
1TE(INDEX,2).AND.NDATE(I,3).EQ.NSDTE(INDEX,3))GO TO 315
317    CONTINUE
      NSNOW=0
      GO TO (309,313),MASH
309    DREC=AREC(I)-ABASE
      ACC=ACC+DREC
      TRACE=TR(1)
      IF(IX.LT.12) GO TO 328
      WRITE(6,329)
329    FORMAT(1H )
      IF(NSKIP.EQ.1) GO TO 4000
      LX=I-1
      TYPE=TR(1)
      IF(LX.EQ.0) GO TO 392
      KTMO=NDATE(LX,1)
      KTDA=NDATE(LX,2)
      KTYR=NDATE(LX,3)
      KTHR=NDATE(LX,4)
      KTMN=NDATE(LX,5)
      KTX=NY11
392    AKTC=ACC-DREC
      WRITE(6,27)GAGE,KTMO,KTDA,KTY,KTYR,KTHR,KTMN,TRACE,ATR
1EC,TYPE,AKTC,NCOD
      WRITE(KT)IWID,GAGE,KTMO,KTDA,KTY,KTYR,KTHR,KTMN,TRACE,
1ATREC,TYPE, NCOD
      KSEQ=KSEQ+1
      GO TO 328
328    TYPE=TR(1)
      IF(NSNOW.EQ.1) TYPE=STYPE(NDEX)
      IF(NSKIP.EQ.1) GO TO 4000
      WRITE(6,27) GAGE,(NDATE(I,M),M=1,2),NY11,(NDATE(I,N),N
1=3,5),TRACE ,DREC,TYPE,ACC,NCOD
27    FORMAT(23X, 3A4,3X,I2,4X,I2,4X,2I2,3X,I2,3X,I2,5X,A1,7
1X,F5.1,9X,A1,4X,F5.1,4X,I4)
      WRITE(KT) IWID,GAGE,(NDATE(I,M),M=1,2),NY11,(NDATE(I,N
1),N=3,5),TRACE,DREC,TYPE,NCOD

```

```

      KSEQ=KSEQ+1
4000 IF(NDATE(I,4).EQ.24) NSNOW=0
      NEED=1
      NTIC=0
      ITIC=0
      ABASE=AREC(I)
      NGQ=0
      IX=0
      NUT=1
      GO TO 312
401  ABASE=AREC(KIX)
      I=KIX
      IF(NJOE.EQ.2) GO TO 403
      GO TO 313
315  NSNOW=1
      NDEX=INDEX
      GO TO (309,313),MASH
C
C X X X X X X X JOINING OF TRACE AND NO TRACE ROUTINES
C
313  IX=IX+1
      IF(NDATE(I,4).EQ.24) NSNOW=0
312  IF(I.EQ.J) GO TO 311
      I=I+1
      GO TO 307
C
C X X X X X TRACE IN ROUTINE
C
350  IF(AREC(I).GT.ABASE) GO TO 351
403  IF(ISTORE.EQ.1) GO TO 352
      IF(ATRA(I).NE.8.0) GO TO 354
360  ISTORE=1
      ITMO=NDATE(I,1)
      ITDA=NDATE(I,2)
      ITYR=NDATE(I,3)
      ITHR=NDATE(I,4)
      ITMN=NDATE(I,5)
355  ITIC=1
      IF(NSNOW.EQ.1) GO TO 313
      MASH=2
      GO TO 316
354  ITIC=0
      IF(NEED.EQ.1) NTIC=NTIC+1
      IF(NTIC.LT.12) GO TO 313
      NEED=0
      NTIC=0
      GO TO 313
364  KSEQ=KSEQ+1
4001 ISTORE=0
      ITIC=0

```

```

        NTIC=0
        IX=0
        NUT=1
        IF(NGO.EQ.1) GO TO 310
        GO TO 313
352    IF(NEED.EQ.1) GO TO 365
        IF(ITIC.EQ.12) GO TO 366
        ITIC=ITIC+1
        GO TO 313
365    IF(NTIC.GE.12) GO TO 390
        NTIC=NTIC+1
        GO TO 313
390    NEED=0
        ISTORE=0
        NTIC=0
        ITIC=0
        GO TO 313
366    IF(NSNOW.NE.0) GO TO 367
        IF(ATRA(1).EQ.8.) GO TO 360
        ISTORE=0
        ITIC=0
        GO TO 313
367    IF(NDATE(1,4).NE.24) GO TO 355
        ACC=ACC+ATREC
        IF(NSKIP.EQ.1) GO TO 4001
        WRITE(6,329)
        WRITE(6,27) GAGE,ITMO,ITDA,NY11,ITYR,ITHR,ITMN,TR(2),A
1TREC,STYPE(NDEX),ACC,NCOD
        WRITE(KT) IWID,GAGE,ITMO,ITDA,NY11,ITYR,ITHR,ITMN,TR(2
1),BTREC,STYPE(NDEX),NCOD
        NSNOW=0
        GO TO 364
351    KIX=I+1
        NJOE=2
        IF(KIX.EQ.J) GO TO 402
        IF(AREC(KIX).EQ.ABASE) GO TO 401
402    ADIFF=AREC(I)-ABASE
        IF(ADIFF.GT.GREF) GO TO 368
        TRACE=TR(2)
        TYPE=TR(1)
        IF(NSNOW.EQ.1) TYPE=STYPE(NDEX)
        IF(NEED.EQ.1) GO TO 391
        IF(ISTORE.EQ.1) GO TO 370
        ITIC=0
        GO TO 310
370    WRITE(6,329)
        ACC=ACC+ATREC
        IF(NSKIP.EQ.1) GO TO 371
        WRITE(6,27) GAGE,ITMO,ITDA,NY11,ITYR,ITHR,ITMN,TRACE,A
1TREC,TYPE, ACC,NCOD

```

```

WRITE(KT) IWID,GAGE,ITMO,ITDA,NY11,ITYR,ITHR,ITMN,TRAC
1E,BTREC,TYPE,NCOD
371 NGO=1
    IF(NSKIP.EQ.1) GO TO 4001
    GO TO 364
391 NGO=1
    GO TO 4001
368 IF(ISTORE.EQ.1) GO TO 352
    GO TO 313
311 KTMO=NDATE(J,1)
    KTDA=NDATE(J,2)
    KTY=NY11
    KTYR=NDATE(J,3)
    KTHR=NDATE(J,4)
    KTMN=NDATE(J,5)
    RETURN
    END
SUBROUTINE RUNOFF
LOGICAL*1 OUT2(6),ACARD(80)
COMMON OUT2,ACARD
COMMON/BLK1/STYPE(999),AREC(257),CREC(257),ATRA(257),C
1TRA(257), GAGE(3),GAG(3),NSDTE(999,3),NDATE(257,5)
COMMON/BLK2/J,I,L,NSTOP,NCHECK,NSTORE,ISTORE,ICHECK,NI
1CE, NWSH,KSEQ,NSEQ,NOTE,MIAC,NSKIP,NLIST,NPFG,
2NOPT,NCPT,NIPT,NTYPE,NX,KB,IX,MAXNO,IECF,NOECF,NCOD,IT
3,KT,NSTART,LDATA,ELEREF,NSC,YACC,ACC,NTRACE,ABASE,NSNO
4W,INDEX,NGO,NEED,NUT,ATREC,BTREC,ITIC ,NDST,
5NTINT,LTINT,NORM,LHEC,DREC,NTIC,ADIFF,NFIRST,NREFE,NPI
6L
COMMON/BLK3/NH1,NY22,NMIN,IYR,MT1,NM1,NY2,NMONTH,IHR,N
1D1,ARD1,NH2,NDAY,IMO,IMN,NY11,MT2,NM2,NYEAR,IDA,NY1,ND
22,ARD2,NHOUR,NYE,NYXX, ITMO,ITDA,ITYR,ITHR,ITMN,GREF,
3MASH,NDEX,KTMO,KTDA,KTY,KTYR,KTHR, KTMN,NSTARE,IY,ARE
4D,MTINT,IWID
COMMON/BLK4/LLL(12)/BLK5/TR(2)
IF(NICE.EQ.1) GO TO 229
LTINT=1
WRITE(6,12)
12 FORMAT(26X,'GAGE',7X,'MONTH DAY YEAR',4X,
2'TIME TIME DISCHARGE DEPTH CODE'/26X,' NO.',2
17X,'HR MIN INTR TABLE NO. (FT)'/)
C X X X X X X X X X X WRITE BEGINNING DATE TIME GAGE HEIGHT IF
C THE FIRST
C X X X X X X X X X X READING OF A PAPER TAPE
WRITE(6,46) GAGE,MT1,ND1,NY11,NY1,NH1,NM1,ARD1,NCOD
46 FORMAT(2X,'BEGIN OF TAPE LABEL= ',3A4,3X,I2,4X,I2,4X,
12I2, 3X,I2,3X,I2,21X,F6.2,4X,I4/)
C TESTING BEGINNING NUMBER OF AREC(J'S)
IF(NSTART.EQ.0) GO TO 230
IF(NDATE(1,1).EQ.NDATE(257,1).AND.NDATE(1,2).EQ.NDATE(

```



```

1257,2).AND.NDATE(1,3).EQ.NDATE(257,3).AND.NDATE(1,4).E
2Q.NDATE(257,4).AND.NDATE(1,5).EQ.NDATE(257,5)) GO TO 2
331
GO TO 229
231 AREC(1)=AREC(256)
DO 298 M=1,5
298 NDATE(1,M)=NDATE(256,M)
NSTART=0
GO TO 229
230 I=1
K=2
NTINT=1
GO TO 18
229 NTINT=NTINT+1
I=1
K=2
C X X X X X X X X ROUTINE TO EDIT OUT EXTRANEQUS READINGS,
C WRITE ON MAG
18 IF(NSTART.EQ.1) GO TO 17
19 IF(AREC(I).GT.GREF) AREC(I)=0.0
IF(AREC(K).GT.GREF) AREC(K)=0.0
IF((AREC(I).EQ.AREC(K)).AND.(NDATE(K,4).NE.24)) GO TO
125
IF(NSKIP.EQ.1) GO TO 4000
24 IF(LTINT.EQ.1) GO TO 4003
4005 IF(NLIST.EQ.0) GO TO 300
WRITE(6,27) GAGE,(NDATE(1,M),M=1,2),NY11,(NDATE(1,N),
1N=3,5),NTINT,NDST,AREC(I),NCOD
27 FORMAT(23X, 3A4,3X,I2,4X,I2,4X,2I2,3X,I2,3X,I2,4X,I3,7
1X,I1,6X,F6.2,4X,I4)
300 WRITE(KT) IWID,GAGE,(NDATE(1,M),M=1,2),NY11,(NDATE(1,N
1),N=3,5),NTINT,NDST,AREC(I),NCOD
KSEQ=KSEQ+1
MTINT=NTINT
4000 L=I
NUT=1
45 I=K
NTINT=0
25 IF(K.EQ.J) GO TO 23
NTINT=NTINT+1
K=K+1
GO TO 19
4003 WRITE(6,4004)GAGE,(NDATE(1,M),M=1,2),NY11,(NDATE(1,N),
1N=3,5),NTINT,NDST,AREC(I),NCOD
4004 FORMAT(1X,'FIRST RECGD ON MAG.= ', 3A4,3X,I2,4X,I2,4X
1,2I2, 3X,I2,3X,I2,4X,I3,7X,I1,6X,F6.2,4X,I4/)
LTINT=0
GO TO 4005
C X X X X X X X X ROUTINE USED AFTER FIRST TIME THRU (NSTA
C RT=1)

```

```

17 IF(AREC(I).GT.GREF) AREC(I)=0.0
   IF(AREC(I).EQ.AREC(256).AND.NDATE(I,4).NE.24) GO TO 70
   IF(LTINT.EQ.1) GO TO 4006
4007 IF(NSKIP.EQ.1) GO TO 4001
   IF(NLIST.EQ.0) GO TO 305
   WRITE(6,27) GAGE,(NDATE(256,M),M=1,2),NYXX,(NDATE(256
1,N),N=3, 5),NTINT,NDST,AREC(256),NCOD
305 WRITE(KT) IWID,GAGE,(NDATE(256,M),M=1,2),NYXX,(NDATE(2
156,N),N=3, 5),NTINT,NDST,AREC(256),NCOD
   KSEQ=KSEQ+1
   MTINT=NTINT
4001 NTINT=1
   L=256
   NUT=1
   GO TO 19
4006 WRITE(6,4004)GAGE,(NDATE(256,M),M=1,2),NYXX,(NDATE(256
1,N),N=3, 5),NTINT,NDST,AREC(256),NCOD
   LTINT=0
   GO TO 4007
70 AREC(I)=AREC(256)
   DO 75 M=1,5
   NDATE(I,M)=NDATE(256,M)
75 CONTINUE
   NTINT=NTINT+1
   GO TO 19
23 NSTART=1
   IF(NCHECK.EQ.0) GO TO 55
   IF(NSTOP.EQ.1.OR.NWSH.EQ.1) NSTART=0
   IF((NSTOP.EQ.1).OR.(NWSH.EQ.1)) GO TO 95
   IF(NCOD.EQ.1000.AND.LDATA.EQ.0) GO TO 800
   IF(NCOD.GE.0010.AND.NCOD.LT.0050) NSTART=0
   IF(NCOD.GT.1000.AND.NCOD.LT.1050) NSTART=0
   IF(NCOD.GE.0100.AND.NCOD.LE.0116) NSTART=0
   IF(NCOD.GE.1100.AND.NCOD.LE.1116) NSTART=0
   IF(NCOD.GE.0118.AND.NCOD.LE.0132) NSTART=0
   IF(NCOD.GE.1118.AND.NCOD.LE.1132) NSTART=0
   IF(NCOD.GT.0133.AND.NCOD.LE.0199) NSTART=0
   IF(NCOD.GT.1133.AND.NCOD.LE.1199) NSTART=0
   IF(LDATA.NE.0) NSTART=0
   IF(NSTART.EQ.0) GO TO 95
   GO TO 800
95 IF(NTINT.EQ.0) GO TO 21
   IF(NSKIP.EQ.1) GO TO 4002
   IF(LTINT.EQ.1) GO TO 4008
4009 IF(NLIST.EQ.0) GO TO 42
   WRITE(6,27) GAGE,(NDATE(I,M),M=1,2),NY11,(NDATE(I,N),
1N=3,5),NTINT,NDST,AREC(I),NCOD
42 WRITE(KT) IWID,GAGE,(NDATE(I,M),M=1,2),NY11,(NDATE(I,N
1),N=3,5),NTINT,NDST,AREC(I),NCOD
   KSEQ=KSEQ+1

```

```

      MTINT=NTINT
4002 L=I
      NUT=1
      GO TO 21
4008 WRITE(6,4004)GAGE,(NDATE(I,M),M=1,2),NY11,(NDATE(I,N),
      IN=3,5),NTINT,NDST,AREC(I),NCOD
      LTINT=0
      GO TO 4009
800 DO 801 M=1,5
801  NDATE(257,M)=NDATE(J,M)
      IF(AREC(J).GT.GREF) AREC(J)=0.0
      AREC(257)=AREC(J)
55 DO 36 M=1,5
      NDATE(256,M)=NDATE(I,M)
36 CONTINUE
      NYXX=NY11
      AREC(256)=AREC(I)
21 NICE=1
      RETURN
      END
      SUBROUTINE AQUFER
      LOGICAL*1 OUT2(6),ACARD(80)
      COMMON OUT2,ACARD
      COMMON/BLK1/STYPE(999),AREC(257),CREC(257),ATRA(257),C
      ITRA(257), GAGE(3),GAG(3),NSDTE(999,3),NDATE(257,5)
      COMMON/BLK2/J,I,L,NSTOP,NCHECK,NSTORE,ISTORE,ICHECK,NI
      ICE, NWSH,KSEQ,NSEQ,NOTE,MIAC,NSKIP,NLIST,NPFG,
      2NOPT,NCPT,NTPT,NTYPE,NX,KB,IX,MAXNO,IEOF,NOEOF,NCOD,IT
      3,KT,NSTART,LDATA,ELEREF,NSC,YACC,ACC,NTRACE,ABASE,NSNO
      4W,INDEX,NGO,NEED,NUT,ATREC,BTREC,ITIC ,NDST,
      5NTINT,LTINT,NORM,LHEC,DREC,NTIC,ADIFF,NFIRST,NREFE,NPI
      6L
      COMMON/BLK3/NH1,NY22,NMIN,IYR,MT1,NM1,NY2,NMONTH,IHR,N
      1D1,ARD1,NH2,NDAY,IMO,IMN,NY11,MT2,NM2,NYEAR,IDA,NY1,ND
      22,ARD2,NHOUR,NYE,NYXX, ITMO,ITDA,ITYR,ITHR,ITMN,GREF,
      3MASH,NDEX,KTMO,KTDA,KTY,KTYR,KTHR, KTMN,NSTARE,IY,ARE
      4D,MTINT,IWID
      COMMON/BLK4/LLL(12)/BLK5/TR(2)
      LLPAS=0
      NREFE=0
      DO 21 I=1,J
      IF(AREC(I).GT.GREF) AREC(I)=0.0
      IF(ELEREF.EQ.0.0) GO TO 21
      AREC(I)=ELEREF-AREC(I)
21 CONTINUE
      ARD3=ARD1
      IF(ARD1.GT.GREF) ARD1=0.0
      IF(ARD2.GT.GREF) ARD2=0.0
      IF(ELEREF.EQ.0.0) GO TO 20
      ARD1=ELEREF-ARD1

```

```

NREFE=1
20 IF(NFIRST.EQ.0) GO TO 2
WRITE(6,17) ELEREF,ARD3
17 FORMAT(9X,'ELEVATION REFERENCE=',F8.2,' BEGIN GAGE HE
LIGHT=',F6.2)
WRITE(6,1) GAGE,MT1,ND1,NY11,NY1,NH1,NM1,NREFE,ARD1,NC
100
1 FORMAT(34X,'GAGE MD DAY YEAR TIME NREFE GAGE D
1EPH. CODE'//9X,'BEGIN OF TAPE LABEL= ', 3A4,2X,I2,1X,
2I2,2X,2I2,2X,2I2,3X,I1,6X,F8.2,3X,I4//)
2 I=0
3 I=I+1
4 LMO=NDATE(I,1)
LMD=NDATE(I,2)
LYR=NDATE(I,3)
LHR=NDATE(I,4)
LMN=NDATE(I,5)
AAREC=AAREC(I)
IF(LMN.EQ.30.OR.LMN.EQ.00) GO TO 6
IF(I.EQ.J) GO TO 15
GO TO 3
6 IF(I.EQ.J) GO TO 8
5 IF(NFIRST.EQ.0) GO TO 9
WRITE(6,7) GAGE,LMO,LMD,NY11,LYR,LHR,LMN,NREFE,AAREC,N
1000
7 FORMAT(8X,'FIRST RECORD ON MAG.= ', 3A4,2X,I2,1X,I2,2X
1,I2I2,2X,2I2,3X,I1,6X,F8.2,3X,I4//)
9 IF(NLIST.EQ.0) GO TO 11
WRITE(6,10) GAGE,LMO,LMD,NY11,LYR,LHR,LMN,NREFE,AAREC,
1000
10 FORMAT(30X, 3A4,2X,I2,1X,I2,2X,2I2,2X,2I2,3X,I1,6X,F8.
12,3X,I4)
11 IF(NSKIP.EQ.1) GO TO 13
12 WRITE(KT) IWID,GAGE,LMO,LMD,NY11,LYR,LHR,LMN,NREFE,AA
1REC,NCOD,TR(1)
NUT=1
KSEQ=KSEQ+1
13 NFIRST=0
NDATE(257,1)=LMO
NDATE(257,2)=LMD
NDATE(257,3)=LYR
NDATE(257,4)=LHR
NDATE(257,5)=LMN
AREC(257)=AAREC
IF(LLPAS.EQ.1) GO TO 15
GO TO 3
8 IF(NCHECK.EQ.0) GO TO 18
IF(NCOD.EQ.1000.AND.LDATA.EQ.0) GO TO 15
NERROR=0
IF(NCOD.GE.0010.AND.NCOD.LT.0050) NERROR=1

```

```

IF(NCOD.GT.1000.AND.NCOD.LT.1050) NERROR=1
IF(NCOD.GE.0100.AND.NCOD.LE.0116) NERROR=1
IF(NCOD.GE.1100.AND.NCOD.LE.1116) NERROR=1
IF(NCOD.GE.0118.AND.NCOD.LE.0132) NERROR=1
IF(NCOD.GE.1118.AND.NCOD.LE.1132) NERROR=1
IF(NCOD.GT.0133.AND.NCOD.LE.0199) NERROR=1
IF(NCOD.GT.1133.AND.NCOD.LE.1199) NERROR=1
IF(LDATA.NE.0) NERROR=1
IF(NERROR.EQ.0) GO TO 15
18  LLPAS=1
    GO TO 5
15  NFIRST=0
    RETURN
    END
SUBROUTINE OUTPUT
C X X X X X X X X X WRITE INFORMATION ABOUT THE PAPER TAPE
LOGICAL*1 OUT2(6),ACARD(80)
COMMON OUT2,ACARD
COMMON/BLK1/STYPE(999),AREC(257),CREC(257),ATRA(257),C
1TRA(257), GAGE(3),GAG(3),NSDTE(999,3),NDATE(257,5)
COMMON/BLK2/J,I,L,NSTOP,NCHECK,NSTORE,ISTORE,ICHECK,NI
1CE, NWSH,KSEQ,NSEQ,NOTE,MIAC,NSKIP,NLIST,NPFG,
2NOPT,NCPT,NTPT,NTYPE,NX,KB,IX,MAXNO,IEOF,NDOEF,NCOD,IT
3,KT,NSTART,LDATA,ELEREF,NSC,YACC,ACC,NTRACE,ABASE,NSNO
4W,INDEX,NGD,NEED,NUT,ATREC,BTREC,ITIC ,NDST,
5NTINT,LTINT,NORM,LHEC,DREC,NTIC,ADIFF,NFIRST,NREFE,NPI
6L
COMMON/BLK3/NH1,NY22,NMIN,IYR,MT1,NM1,NY2,NMONTH,IHR,N
1D1,ARD1,NH2,NDAY,IMD,IMN,NY11,MT2,NM2,NYEAR,IDA,NY1,ND
22,ARD2,NHOUR,NYE,NYXX, ITMO,ITDA,ITYR,ITHR,ITMN,GREF,
3MASH,NDEX,KTMO,KTDA,KTY,KTYR,KTHR, KTMN,NSTARE,IY,ARE
4D,MTINT,IWID
COMMON/BLK4/LLL(12)/BLK5/TR(2)
NSEQ=NSEQ+KSEQ
IF(NTYPE.EQ.1) GO TO 400
IF(NTYPE.EQ.2) GO TO 401
GO TO 402
400  BREC=AREC(J)
    BRD2=ARD2*10.0
    WRITE(6,48) NOPT,GAGE,MT2,ND2,NY22,NY2,NH2,NM2,BRD2,(ND
1ATE(J,M),M=1,2),NY22,(NDATE(J,N),N=3,5),BREC,KSEQ,MIAC
2,NPIL
48  FORMAT(1H0,16X,'END OF TAPE NO.',I2,',',FOR GAGE-', 3A4,
1' END OF TAPE ON LABEL=',I2,'/',I2,'/',2I2,' TIME=',
2I2,I2,' READING=',F4.1/58X,'END OF TAPE COMPUTED =',I2
3,'/',I2,'/',2I2,' TIME=',I2,I2,' READING=',F4.1/28X,'
4THE NO. OF RECORDS WRITTEN=',I5/28X,'THE TOTAL NO. OF
5PUNCHES FOR PAPER TAPE WAS COMPUTED TO BE=',I5,' PUNC
6H INTERVAL=',I2/)
    YACC=YACC+ACC

```

```

      IF(NWSH.EQ.0) GO TO 453
      WRITE(6,452) YACC
452  FORMAT(28X,'TOTAL PRECIPITATION FOR GAGE=',F5.1/)
453  IF(NUT.EQ.0) GO TO 449
      GO TO 450
401  IF(NUT.EQ.0) GO TO 449
      WRITE(6,54) GAGE,(NDATE(L,M),M=1,2),NY22,(NDATE(L,MM),M
      1M=3,5),MTINT,NDST,AREC(L),NCOD
54   FORMAT('0',2X,'LAST RECORD ON MAG= ',3A4,3X,I2,4X,I2,
      14X,2I2,3X,I2,3X,I2,4X,I3,7X,I1,6X,F6.2,4X,I4//)
      NUT=0
550  WRITE(6,50) NOPT,GAGE,MT2,ND2,NY22,NY2,NH2,NM2,ARD2,(NDATE(J,M),M=1,2),NY22,(NDATE(J,N),N=3,5),AREC(J),KSEQ,N
      2SEQ,MIAC,NPIL
50   FORMAT(3X,'END OF TAPE NO.',I2,',',FOR GAGE-',3A4,', EN
      1D OF TAPE ON LABEL=',I2,'/',I2,'/',2I2,' TIME=',I2,I2,
      2' READING=',F6.2/44X,'END OF TAPE COMPUTED=',I2,'/',I2
      3,'/',2I2,' TIME=',I2,I2,' READING=',F6.2/44X,'THE NO.
      4OF RECORDS WRITTEN=',I5//12X,'TOTAL RECORDS WRITTEN ON
      5 MAG. TAPE SINCE BEGINNING=',I6//28X,'THE TOTAL NO. OF
      6 PUNCHES FOR PAPER TAPE WAS COMPUTED TO BE=',I5,' PUNC
      7H INTERVAL=',I2/)
      GO TO 450
449  WRITE(6,555)
555  FORMAT(12X,'NO RECORDS WRITTEN ON TAPE FOR THIS PAPER
      1TAPE'/)
      IF(NTYPE.EQ.2) GO TO 550
450  WRITE(6,49) OUT2,NCOD
      49 FORMAT(12X,'DATA FOR PAPER TAPE WRITTEN ON TAPE NO.',I6
      1A1,',FOR STORAGE-- THE ERROR CODE FOR TAPE=',I4//)
      IF(NTYPE.EQ.2) GO TO 3004
      WRITE(6,3003) NSEQ
3003  FORMAT(12X,'(I6,')=TOTAL NO. OF RECORDS WERE WRITTEN
      1 ON MAGNET. TAPE THROUGH THIS POINT DURING FIRST EDIT'
      2//)
3004  CALL ERMESG(NCOD)
      GO TO 3005
402  IF(NUT.EQ.0) GO TO 815
      MON=NDATE(257,1)
      NDAE=NDATE(257,2)
      NYER=NDATE(257,3)
      NHUR=NDATE(257,4)
      NIM=NDATE(257,5)
      CTREC=AREC(257)
      WRITE(6,814) GAGE,MON,NDAE,NY22,NYER,NHUR,NIM,NREFE,CT
      1REC,NCOD
814  FORMAT('0',8X,'LAST RECORD ON MAG.= ',3A4,2X,I2,1X,I2
      1,2X,2I2,2X,2I2,3X,I1,6X,F8.2,3X,I4/)
815  MO=NDATE(J,1)
      NDA=NDATE(J,2)

```

```

      NYR=NDATE(J,3)
      NHR=NDATE(J,4)
      NMN=NDATE(J,5)
      TTREC=AREC(J)
      ARD3=ARD2
      IF(ELEREF.EQ.0.0) GO TO 817
      ARD3=ELEREF-ARD2
817  WRITE(6,816) ARD2
816  FORMAT(37X,'ENDING GAGE HEIGHT LABEL=',F8.2/)
813  WRITE(6,600) MT2,ND2,NY22,NY2, NH2,NM2,ARD3,MO,NDA,NY2
      12,NYR,NHR, NMN,TTREC,NCOD,KSEQ,OUT2,NSEQ
600  FORMAT(1H,36X,'ENDING ON TAPE LABEL=',I2,'-',I2,'-',I2,
      1I2,4X,2I2,4X,F8.2/37X,'END OF TAPE COMPUTED=',I2,'-',I2,
      22,'-',I2,4X,2I2,4X,F8.2/37X,'ERROR CODE FOR PAPER TAP
      3E-',I4/37X,I5,'-RECORDS WRITTEN FOR PAPER TAPE'/37X,'R
      4ECORDS WERE WRITTEN ON MAG. TAPE-',6A1/37X,'A TOTAL OF
      5 -',I5,'RECORDS WERE WRITTEN ON MAG. AT THIS POINT')
      NUT=0
      GO TO 3004
3005 KSEQ=0
      IF(LDATA.EQ.0) GO TO 30
      DO 5000 NNN=1,LDATA
      READ(5,3001) ACARD
3001 FORMAT(80A1)
      WRITE(6,3002) ACARD
3002 FORMAT(28X,80A1)
5000 CONTINUE
30  RETURN
      END
      SUBROUTINE ERMESG(I)

```

```

C
C SUBROUTINE ERMESG (REVISED BY JAN C CARR 10/71)
C A MESSAGE IS PRINTED FOR AN ERROR CODE (NCOD) FOLLOWING T
C HE EDIT
C OF A PAPER TAPE, DESCRIBING THE TYPE ERROR THAT IS PRESEN
C T FOR THE
C DATA STORED
C
C INVOKED BY :: CALL ERMESG(NCOD)
C WHERE NCOD IS A VARIABLE OR CONSTANT VALUE OF ERROR CODE
C
C NCOD MUST BE BETWEEN THE RANGES OF (10 TO 199),(1010 TO 1
C 199),OR,
C (1000 OR 2000)
C
C
C
      II=I
      IF(I.EQ.1000.OR.I.EQ.2000) GO TO 817
      IF(I.GE.10.AND.I.LE.199) GO TO 818
      IF(I.GE.1010.AND.I.LE.1199) GO TO 819

```

```

818 PRINT 820,I
820 FORMAT(20X,'ERROR CODE(',I4,')LAST VALUE PUNCHED ON TA
1PE DOES NOT AGREE WITH TRUE GAUGE VALUE')
GO TO 811
819 PRINT 821,I
821 FORMAT(20X,'ERROR CODE(',I4,')LAST VALUE PUNCHED ON TA
1PE IS TRUE GAGE VALUE')
811 IF((I.GE.10.AND.I.LE.29).OR.(I.GE.1010.AND.I.LE.1029))
1 GO TO 401
IF((I.GE.30.AND.I.LE.49).OR.(I.GE.1030.AND.I.LE.1049))
1 GO TO 501
IF((I.GE.50.AND.I.LE.79).OR.(I.GE.1050.AND.I.LE.1079))
1 GO TO 601
IF((I.GE.80.AND.I.LE.89).OR.(I.GE.1080.AND.I.LE.1089))
1 GO TO 701
IF((I.GE.90.AND.I.LE.99).OR.(I.GE.1090.AND.I.LE.1099))
1 GO TO 801
IF((I.GE.100.AND.I.LE.199).OR.(I.GE.1100.AND.I.LE.1199
1)) GO TO 901
817 IF(I.EQ.1000) GO TO 202
IF(I.EQ.2000) GO TO 201
GO TO 301
202 PRINT 1000,I
1000 FORMAT(20X,'ERROR CODE=(',I4,') GOOD DATA TAPE-NO APPA
1RENT ERRORS ')
RETURN
201 PRINT 2000,I
2000 FORMAT(20X,'ERROR CODE=(',I4,') ESTIMATED DATA AT SOME
1 POINT')
RETURN
301 PRINT 9000,I
9000 FORMAT(20X,'ERROR CODE IS NOT VALID--CODE=',I4)
RETURN
401 PRINT 7000
7000 FORMAT(20X,'TIME LOSS')
IF(I.LT.30) II=I+1000
ID=II-1009
GO TO (10,11,12,13,8,8,8,8,8,8,20,21,22,23,24,25,26,8,
18,8),ID
10 PRINT 1010
GO TO 812
11 PRINT 1011
GO TO 812
12 PRINT 1012
GO TO 812
13 PRINT 1013
GO TO 812
20 PRINT 1020
GO TO 812
21 PRINT 1021

```



```

      GO TO 812
22   PRINT 1022
      GO TO 812
23   PRINT 1023
      GO TO 812
24   PRINT 1024
      GO TO 812
25   PRINT 1025
      GO TO 812
26   PRINT 1026
      GO TO 812
1010 FORMAT(20X,'TIMER FAILURE GAUGE STOPPED')
1011 FORMAT(20X,'LEAF SWITCH FAILURE GAUGE RAN CONTINUOUSLY
1 UNTIL BATTERY FAILED')
1012 FORMAT(20X,'TIMER FAILURE-INTERMITTANT OPERATION')
1013 FORMAT(20X,'TIMER FAILURE-TIME DIFFERENCE AT END OF PA
1PER TAPE')
1020 FORMAT(20X,'NO APPARENT REASON')
1021 FORMAT(20X,'MISTAKE IN ERROR CODE-HAS NOT BEEN ASSIGNE
ID')
1022 FORMAT(20X,'LEAF SWITCH FAILURE')
1023 FORMAT(20X,'BATTERY FAILURE')
1024 FORMAT(20X,'IMPROPER TAPE INDEXING')
1025 FORMAT(20X,'PUNCH MOTOR OPERATES INTERMITTANTLY')
1026 FORMAT(20X,'PUNCH MOTOR FAILURE')
501 PRINT 6000
6000 FORMAT(20X,'TIME GAIN')
      IF(I.LT.50) II=I+1000
      ID=II-1029
      GO TO (30,12,11,20,22,24,23,8,8,8,8,8,8,8,8,8,8,8,8,8)
1, ID
30   PRINT 1030
1030 FORMAT(20X,'TIMER FAILURE 2-1/2 MINUTE PUNCH INTERVAL'
1)
      GO TO 812
601 PRINT 5000
5000 FORMAT(20X,'INCORRECT RECORDS CODE')
      IF(I.LT.80) II=I+1000
      ID=II-1049
      GO TO (24,51,52,53,54,55,56,57,58,59,60,8,8,8,8,8,8,67
1,68,8,70,71,72,73,8,8,8,8,78,79), ID
51   PRINT 1051
      GO TO 812
52   PRINT 1052
      GO TO 812
53   PRINT 1053
      GO TO 812
54   PRINT 1054
      GO TO 812
55   PRINT 1055

```

```

GO TO 812
56 PRINT 1056
GO TO 812
57 PRINT 1057
GO TO 812
58 PRINT 1058
GO TO 812
59 PRINT 1059
GO TO 812
60 PRINT 1060
GO TO 812
67 PRINT 1067
GO TO 812
68 PRINT 1068
GO TO 812
70 PRINT 1070
GO TO 812
71 PRINT 1071
GO TO 812
72 PRINT 1072
GO TO 812
73 PRINT 1073
GO TO 812
78 PRINT 1078
GO TO 812
79 PRINT 1079
GO TO 812
1051 FORMAT(20X, 'GAUGE INSENSITATIVE AT SOME POINT ON RECOR
1D')
1052 FORMAT(20X, 'SNOW WITH FUNNEL IN PLACE')
1053 FORMAT(20X, 'INTAKE SILT PROBLEM')
1054 FORMAT(20X, 'INTAKE PIPE STOPPED UP')
1055 FORMAT(20X, 'DRIFTING SNOW')
1056 FORMAT(20X, 'FOREIGN MATTER IN COLLECTOR')
1057 FORMAT(20X, 'CABLE BREAKAGE')
1058 FORMAT(20X, 'GAUGE TAMPERED WITH')
1059 FORMAT(20X, 'FUNNEL FALLEN INTO COLLECTOR')
1060 FORMAT(20X, 'PRECIPITATION LOSS NO REASON')
1067 FORMAT(20X, 'PAPER TAPE SUPPLY RAN OUT')
1068 FORMAT(20X, 'TIMER TURNED TO TEST POSITION')
1070 FORMAT(20X, 'NOTCH OF WEIR PROBLEM(ICE)')
1071 FORMAT(20X, 'LOG JAMS OR DEBRE IN NOTCH')
1072 FORMAT(20X, 'VALUE GREATER THAN RANGE OF INSTRUMENT AT
1SOME POINT')
1073 FORMAT(20X, 'FLOAT TAPE DISENGAGED FROM RECORDER')
1078 FORMAT(20X, 'ICE JAMMING(CAUSE HIGH G.H.)')
1079 FORMAT(20X, 'HEAVY ICED CREEK')
701 PRINT 4000
4000 FORMAT(20X, 'TRACE MALFUNCTION CODE')
IF(I.LT.90) II=I+1000

```

```

      ID=II-1079
      GO TO (80,81,82,8,8,8,8,8,8,8),ID
80    PRINT 1080
      GO TO 812
81    PRINT 1081
      GO TO 812
82    PRINT 1082
      GO TO 812
1080  FORMAT(20X,'TRACE WITHOUT PRECIPITATION')
1081  FORMAT(20X,'PRECIPITATION WITHOUT TRACE PUNCHES')
1082  FORMAT(20X,'TRACE INCONSISTENT')
801  PRINT 3000
3000  FORMAT(20X,'TRANSLATOR ERRORS')
      IF(I.LT.100) II=I+1000
      ID=II-1089
      GO TO (90,91,8,8,8,8,8,8,8,8),ID
90    PRINT 1090
      GO TO 812
91    PRINT 1091
      GO TO 812
1090  FORMAT(20X,'READ HEAD MALFUNCTION AT SOME PCINT ON REC
10RD')
1091  FORMAT(20X,'MANNUALLY INSERTED READING ON DOUBLE PUNCH
1 WRONG')
901  PRINT 10000
10000 FORMAT(20X,'COMPLEX ERROR CODES')
      IF(I.LT.1200) II=I+1000
      IF(II.GE.1135.AND.II.LE.1199) GO TO 8
      ID=II-1099
      GO TO (100,100,102,103,103,105,106,113,108,108,110,111
1,111,113,113,115,115,117,118,119,120,121,122,123,124,1
225,126,127,128,129,130, 131,131,133,134),ID
100  PRINT 1024
200  PRINT 1026
      GO TO 812
102  PRINT 1080
      GO TO 200
103  PRINT 1020
500  PRINT 1082
      GO TO 812
105  PRINT 1024
600  PRINT 1023
      GO TO 812
106  PRINT 1024
      GO TO 600
108  PRINT 1020
700  PRINT 1080
      GO TO 812
110  PRINT 1023
      GO TO 200

```

```

111 PRINT 1024
800 PRINT 1081
GO TO 812
113 PRINT 1024
GO TO 500
115 PRINT 1012
802 PRINT 1051
GO TO 812
117 PRINT 1070
PRINT 1054
GO TO 812
118 PRINT 1060
806 PRINT 1024
GO TO 812
119 PRINT 1013
803 PRINT 1052
PRINT 1055
GO TO 812
120 PRINT 1023
GO TO 803
121 PRINT 1024
804 PRINT 1052
GO TO 812
122 PRINT 1024
GO TO 804
123 PRINT 1024
805 PRINT 1057
GO TO 812
124 PRINT 1024
GO TO 805
125 PRINT 1055
GO TO 804
126 PRINT 1052
GO TO 200
127 PRINT 1013
GO TO 700
128 PRINT 1023
GO TO 700
129 PRINT 1030
GO TO 200
130 PRINT 1081
GO TO 806
131 PRINT 1024
807 PRINT 1091
GO TO 812
133 PRINT 1072
PRINT 1073
GO TO 812
134 PRINT 1020
GO TO 800

```

```
8      PRINT 80001
80001  FORMAT(20X,'ERROR CODE HAS NOT BEEN ASSIGNED')
812    RETURN
      END
      BLOCK DATA
      COMMON/BLK4/LLL(12)/BLK5/TR(2)
      DATA LLL/31,28,31,30,31,30,31,31,30,31,30,31/,TR/1H,1
1HT/
      END
```

